

# A CRITICAL CONSIDERATION OF PRIMARY SUB-TROCHANTERIC OSTEOTOMY AND INTERNAL FIXATION FOR RECENT INTRACAPSULAR FRACTURES OF THE FEMORAL NECK.

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A STUDY of the end results of treatment for intracapsular fractures with the Smith-Petersen nail shows that most surgeons claim 70-80 per cent bone unions and all complain about the frequency (25 per cent) of avascular necrosis of the head in the first year; and later. A bone graft has been used by Patrick (1949) and others to supplement the nail with the object of improving these results. But Ettore (1936), McMurray (1938), Dawkins (1941) and, more recently, Blount have proposed primary osteotomy as a big improvement on simple nailing for the following reasons:—

(1) Sub-trochanteric osteotomy often causes bone union of the old and ununited fracture; consequently, if used in recent fractures, it should increase the number of bone unions.

(2) If the osteotomy fails to cause bone union of the fractured neck of the femur, "it leaves a hip joint that is perfectly stable, on which the patient can walk without discomfort and without pain." (McMurray, 1938.)

(3) It usually cures or relieves the pain and weakness caused by the degenerative changes in the hip joint (traumatic osteoarthritis), which follow upon avascular necrosis of the united femoral head.

If any one of these statements were true, the operation of primary osteotomy would be justified. McMurray (1938) stated that he had used the method successfully in four recent fractures and strongly recommended it instead of simple nailing. According to Platt (1947), McMurray had performed primary osteotomy for 23 recent fractures and had obtained bone union of the osteotomy and fractures in all cases. Blount (1943) advised internal fixation of the fracture and osteotomy, thereby avoiding the difficulty of controlling the fragments in a plaster spica and

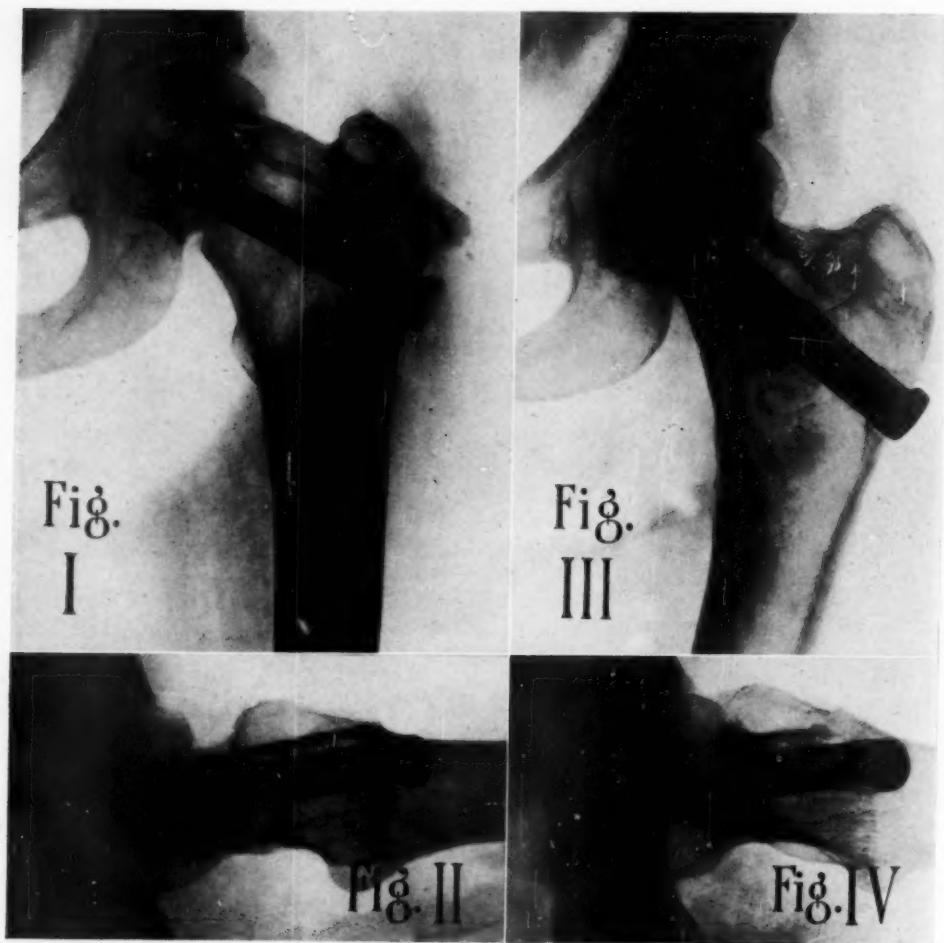
also the danger of non-union of the osteotomy (5 per cent; Table 4). But up to the present "no comprehensive series based on observation for a sufficient length of time have been published." (Linton, 1944.)

## INDICATIONS FOR PRIMARY OSTEOTOMY.

In the last three years I have used the combination of nailing the reduced fracture and internal fixation of the primary osteotomy, instead of the simple Smith-Petersen nailing, for every recent fracture unless the patient was moribund. The first 50 consecutive patients treated by primary osteotomy are reported on in this paper, with the object of comparing the advantages and disadvantages with those of the combined nail-graft and simple nailing procedures. I felt justified in using the method because of gratifying experiences in ununited fractures (column D, Table 1) and also on the recommendation of the authorities quoted above. Although primary osteotomy was used for every recent fracture operated on, other surgeons use it only in special circumstances such as:

- (1) If the fracture is over four weeks old and the neck shows early absorption. Simple nailing may not be successful.
- (2) If the lateral X-ray view on the orthopaedic table shows that the fracture has not been accurately reduced.
- (3) If the neck is comminuted, especially if the splintering of the neck extends into the trochanteric region.
- (4) If there is a large posterior defect in the neck.
- (5) If the bone is decalcified and soft.
- (6) If the patient is a heavy manual labourer, under 50, in whom generalized or localized degenerative changes in the head of the femur might prejudice his livelihood.
- (7) If osteo-arthritis of the hip is present in patients who have sustained a recent fracture.
- (8) If the vertical type of fracture is present.

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FIGS. I and II: Aged 73, operation August 22nd, 1939. Nail and fibula graft for recent fracture.

FIGS. III and IV: (nine years later), May 19th, 1948, same patient, now aged 82, normal function: no aseptic necrosis. This method was abandoned because of the frequency of degenerative changes in the head compared with simple nailing: no significant increase in bone unions; shock and infection were more frequent.

#### ADVANTAGES OF OSTEOTOMY.

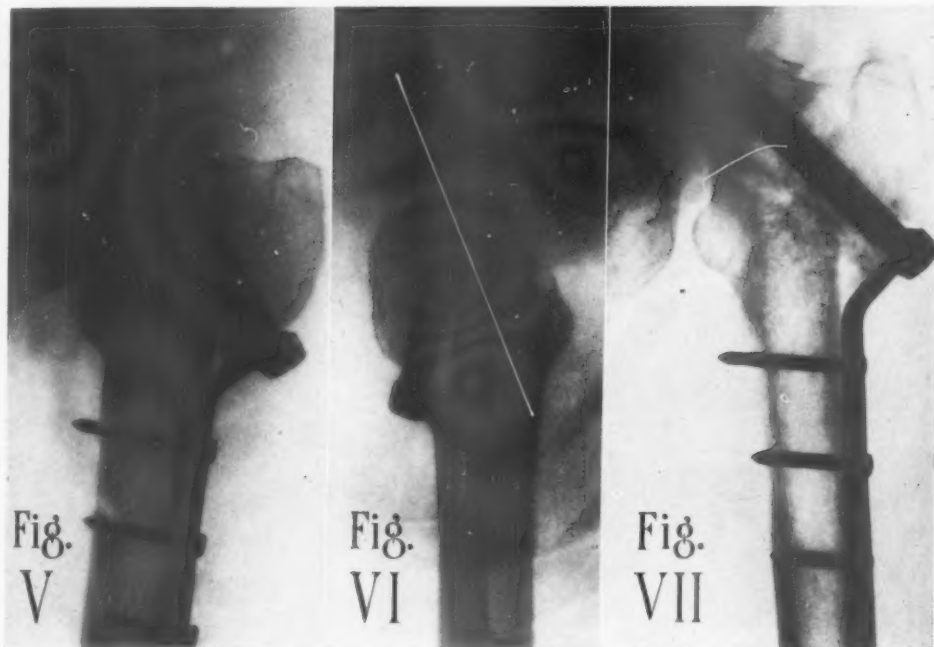
##### (a) *Re-alignment of the fracture.*

After the nail has transfixed the head of the femur and the osteotomy has been performed, the 125° angle plate is attached to the nail-head and is used to adduct the upper fragments (Fig. XXIV). The fracture line then becomes almost horizontal as in abduction or impacted fractures. If delayed union occurs when a fracture-line is horizontal or nearly so, there is no shearing strain.

Theoretically, weight-bearing then causes impaction on the horizontal fracture line to take place and encourages bone union. A number of surgeons — Böhler (1938), Putti (1942), Felsenreich (1937), Boyd and George (1948) — have studied their failures in the light of what Pauwels (1938) proposed, i.e., that non-union was a mechanical problem and depended upon the obliquity of the fracture line; but they denied that his hypothesis was important when put to the test of practical experience. Eyre-Brook

and Pridie (1941) studied carefully the obliquity of the fracture line in 75 hips (final results) and came to the conclusion that technical faults were not so important when the fracture line was inclined to be horizontal, but were important when the fracture line was steep. In other words, it

of the fracture is extracapsular, whereas the upper part is mid-cervical and intracapsular, because it may be mistaken for a trochanteric or extracapsular fracture. X-ray examination after internal rotation and reduction shows that the greater part of this fracture is intracapsular and should be treated accordingly.



FIGS. V and VI: Aged 84; fracture October 20th, 1946; operation October 29th, 1946. Figs. V and VI illustrate two mistakes: The nail is not in the lower part of the femoral head and therefore tends to plough out when the upper fragment is adducted by the plate. The lateral view (Fig. VI) shows the worse error of placing the nail in the anterior half of the femoral head; this usually results in failure. The white line shows the proper direction in the posterior half of the head.

FIG. VII: Same patient three months later. The nail has cut through the front and upper surfaces of the femoral head. The osteotomy is ineffective in preventing shearing of the neck, which takes up a position above the head. Bad functional result: pain, even after the nail is removed.

appears that the solid fixation obtained by a well-placed nail eliminates the shearing force that Pauwels has so convincingly demonstrated. It seems clear enough that sub-capital (high) fractures are more likely to go on to non-union because of the injury to the blood supply (Watson-Jones); the sloping of the fracture line is then of less importance. The prognosis is better in the vertical fractures, which are generally near the base of the neck, because the blood supply is much better. There is another and real danger when the fracture line terminates near the base of the neck so that this part

(b) *Transference of the weight-bearing from the cranio-lateral aspect of the head of the femur to the lateral pelvic wall below the acetabulum.*

This appears to be the real advantage obtained from the Schanz or low sub-trochanteric osteotomy, but is slight or absent from the high or McMurray osteotomy. It favours not only bone union of the fracture by relieving some of the shearing force from the fracture line, but is responsible for the relief of the pain of osteo-arthritis (caused by avascular necrosis) should it develop.

When the osteotomised components are adducted against the lateral pelvic wall and the shaft of the femur is displaced medially, three to four inches of the inner border of the neck and shaft of the femur are now

united fractures some surgeons are now advising the Vitallium cup arthroplasty, arthrodesis, etc., which are dangerous operations in the aged. Sub-trochanteric osteotomy should be tried first.

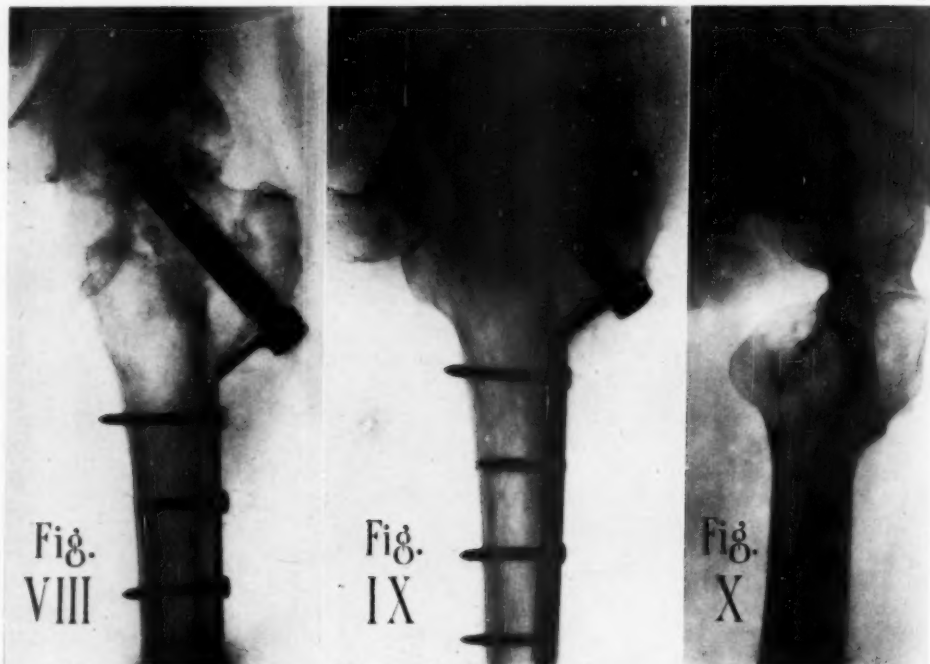


FIG. VIII. Aged 63; fracture April 14th, 1948; operation May 5th, 1948. Shows position on August 8th, 1948, three months after operation, and illustrates a correct osteotomy with the nail in the lower part of the head; adduction of head and neck with horizontal fracture line; impaction of shaft into base of trochanter so that osteotomised femur is close to fracture site and pressure against lateral pelvic wall for relief of pain of avascular necrosis, if it developed.

FIGS. IX and X: Same patient, November 18th, 1948. Frontal view shows union of fracture and osteotomy. Lateral view shows union of fracture and a correct insertion of the nail into the posterior sector of the femoral head; normal function September 16th, 1949; no avascular necrosis.

pressing against the lateral pelvic muscles that cover the upper ramus of the ischium from the lower margin of the acetabulum to the tuber ischii. It is impossible to insert the finger between the projection of the osteotomised fragments and the pelvic bone opposite the tuber ischii when the legs are made parallel on the orthopaedic table. A detailed report after five to ten years is necessary in order to learn how long the relief obtained from osteotomy remains when used for avascular necrosis and osteoarthritis or ununited fractures, etc. For un-

(c) *Displacement of weight-bearing from the cranio-lateral sector of the head of the femur to underneath the fracture line.*

This eliminates or reduces the shearing force on the line of the fracture. It also has the advantage of bringing the raw, cut bone surface of the osteotomised femur to a position underneath the fracture site in the femoral neck and thereby acts as a bone graft. It resembles the raw bone surface of the os calcis when a sub-taloid arthrodesis is performed for non-union of a fractured



talus. The blood vessels that exist and those which develop later from the cut femoral shaft should nourish the head and neck at the site of fracture. This appears to be the main advantage of the Lorenz-McMurray high type of osteotomy and to a lesser extent of a low Schanz osteotomy (Figs. V and VIII illustrate this difference). In Putti's interesting monograph there are a number of illustrations that emphasize this point, which appears to be an important reason for the success of sub-trochanteric osteotomy in causing bone union of an old or ununited fracture.

conceded that 21 per cent of the patients in all developed osteo-arthritis. I could not make this distinction between avascular necrosis and osteo-arthritis. The latter usually started in the cranio-lateral sector of the head and presumably was the result of localized avascular changes in the sub-chondral region of the bone. The nail in the head and neck may cut blood vessels (Tucker, 1948), but the addition of a thick bone graft (taken from the fibula) in the vulnerable upper third of the head and neck must further endanger the blood-supply. Other objections to the removal of a bone

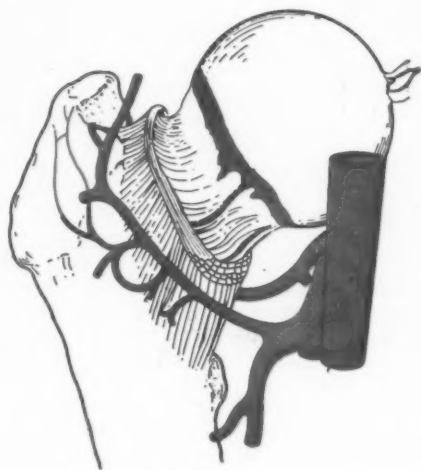


FIG. XI

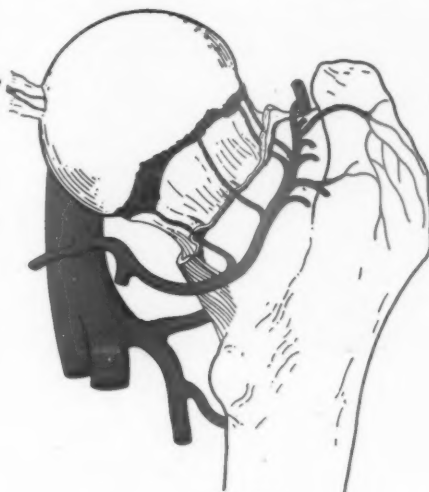


FIG. XII

FIGS. XI and XII: The vessels that enter the head at the retinacular reflection of the synovial membrane may be avulsed by the fracture. The more numerous and larger nutrient arteries that pierce the neck through numerous foramina, and arise from the circular anastomosis, may be affected if one or both circumflex vessels are divided by a chisel or torn during the osteotomy. This may be the reason for primary osteotomy failing to show any significant increase in bone unions over simple Smith-Petersen nailing (after T. von Lanz and W. Wachsmuth: *Praktische Anatomie*. Berlin: J. Springer, 1938).

(d) *Avascular necrosis after primary osteotomy* (see Table 1).

Other surgeons may not confirm the observation that I am venturing to put forward, that aseptic necrosis is less frequent (4 per cent) after primary osteotomy than after nailing (28 per cent). In 31 consecutive cases treated by the combined nail and graft, aseptic necrosis was too common (42 per cent), although Patrick (1949), in 47 consecutive cases, reported that only 8.5 per cent developed this, but he

graft in aged patients were that it sometimes caused shock and the two wounds increased the danger of infection (Table 5). Infected wounds (9.7 per cent out of 31 nailing and grafting operations — admittedly, in pre-penicillin times — against 1.3 per cent in 75 primary osteotomies) and deaths (19.3 per cent against 10 per cent for osteotomies) were too frequent. The addition of a graft to a nailing operation as a routine procedure (Patrick, 1949) appears to introduce only complications instead of improvements in the treatment.

## THE DISADVANTAGES OF PRIMARY OSTEOTOMY

(a) *Non-union at the osteotomy site*  
(Table 4).

This complication has happened only in 7 patients (5 per cent) from a total of 140 sub-trochanteric osteotomies for ununited fractures, osteo-arthritis, etc., treated by external splinting; but there was no instance of non-union in the first 75 recent fractures, of which 50 are detailed in Table 2. The reason for this was almost certainly the internal fixation after impacting the femoral shaft into the base of the trochanteric bone (see under technique).



FIG. XIII. If the nail is driven into the lower third of the head it may rotate (Valgus or abduction position); and should always be transfixed by one or more Kirschner wires that pass into the floor of the acetabulum. Note how the wire is bent in two places because the head tried to rotate. After the nail is inserted, and before the osteotomy, a control X-ray examination is essential.

(b) *Non-union of the fractured femoral neck after osteotomy.*

The results of osteotomy on recent fractures showed no important difference in the number of bone unions compared with simple nailing, with or without grafting. Whatever operative method was used, the successful bone unions were about 70 per cent, and this made it difficult to understand how a late osteotomy often converted a "failed nailing" from non-union into bone union. In Table 1, column D (24 patients with non-union) 7 of the ununited fractures were "failed nailings"; but bone union after a late or secondary osteotomy resulted in 5 successes. The cause of the disappointing absence of any increase in the number of bone unions by primary osteotomy for recent fractures may be as follows:—

In a recent fracture the head is deprived of a portion of the blood supply through the broken neck itself (nutrient vessels); the retinacular arteries arising from the arterial circle around the femoral neck — formed by the ascending branches of the medial and lateral circumflex vessels — are likely to be injured by the fracture, but the circumflex arteries, which are the parents of these retinacular vessels, may be ruptured by the osteotomy; and there remain only the foveolar vessels. The lateral (anterior) circumflex artery is in a very vulnerable position during osteotomy, especially if a chisel and not a saw is used; and the vastus externus is stripped up. This accident also affects the blood supply to the neck and trochanteric bone. The osteotomy may affect the blood supply of the whole of the upper component (trochanter, neck, fracture line and nailed head) by dividing large nutrient vessels at the site of osteotomy which is near the trochanter and the base of the neck. Finally, the trochanteric region and neck may be shattered by the original injury that caused the fracture. The sum total of all these vascular injuries is an inadequate blood supply for from three to six months, i.e., until new blood vessels grow into the bone, to the head of the femur and also into the neck on the distal side of the fracture. This shows how osteotomy can be unfavourable to bone union of the fracture. On the other hand, it is a fact that late osteotomies of ununited fractures may cause union of the fracture (see Table 1, column D). It may be that in these old fractures the head and neck have derived a new blood supply from the surrounding structures during the months of non-union and, consequently, have a fair chance of uniting after a late osteotomy. A patient with a degenerated femoral head or absorbed femoral neck is unsuitable for late osteotomy. Bone union would be unlikely if there were a great deal of fibrous tissue intervening at the fracture site. In a "failed nailing," when the bone has held the fragments in good position, but non-union has resulted, there would not be a formidable fibrous barrier, and such cases are suitable for a late osteotomy.

There is an apparent contradiction between this unexpected failure of primary osteotomy to increase the number of bone unions

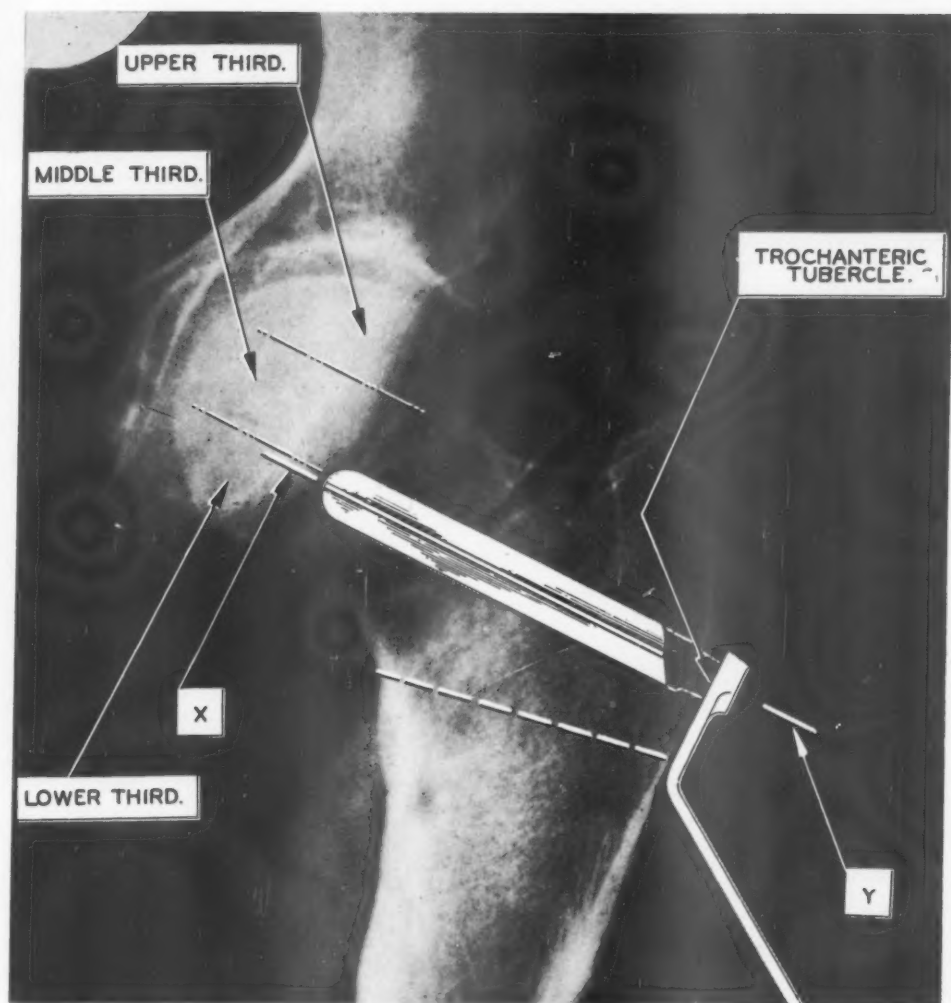


FIG. XIV: Determining the correct neck-shaft angle: The nail and attached 125° angled plate are laid against the wet skiagram (after reduction) so that the nail lies in the lower part of the femoral head and the plate above the angle lies flat on the sub-trochanteric fossa. In this illustration the nail is a little too low. Y is close to the trochanteric tubercle and not lower, as in the simple nailing operation.

(Table 1), and at the same time the rarity of aseptic necrosis — at least in the first year — when bone union occurs. The soundly united head, after a primary osteotomy, may have a better blood supply than after a simple nailing because the osteotomised femoral shaft has a good blood supply; and this has been brought close to the fracture site and to the head. The proximity of this bone might possibly diminish the danger of

avascular necrosis. On the other hand, if the circumflex vessels are injured by an osteotomy operation, non-union is likely. In other words, if the head of the femur survives the vascular dangers of osteotomy, there is, apparently, a smaller chance of avascular necrosis than after simple nailing. Whether this statement and explanation are correct, remain to be seen.

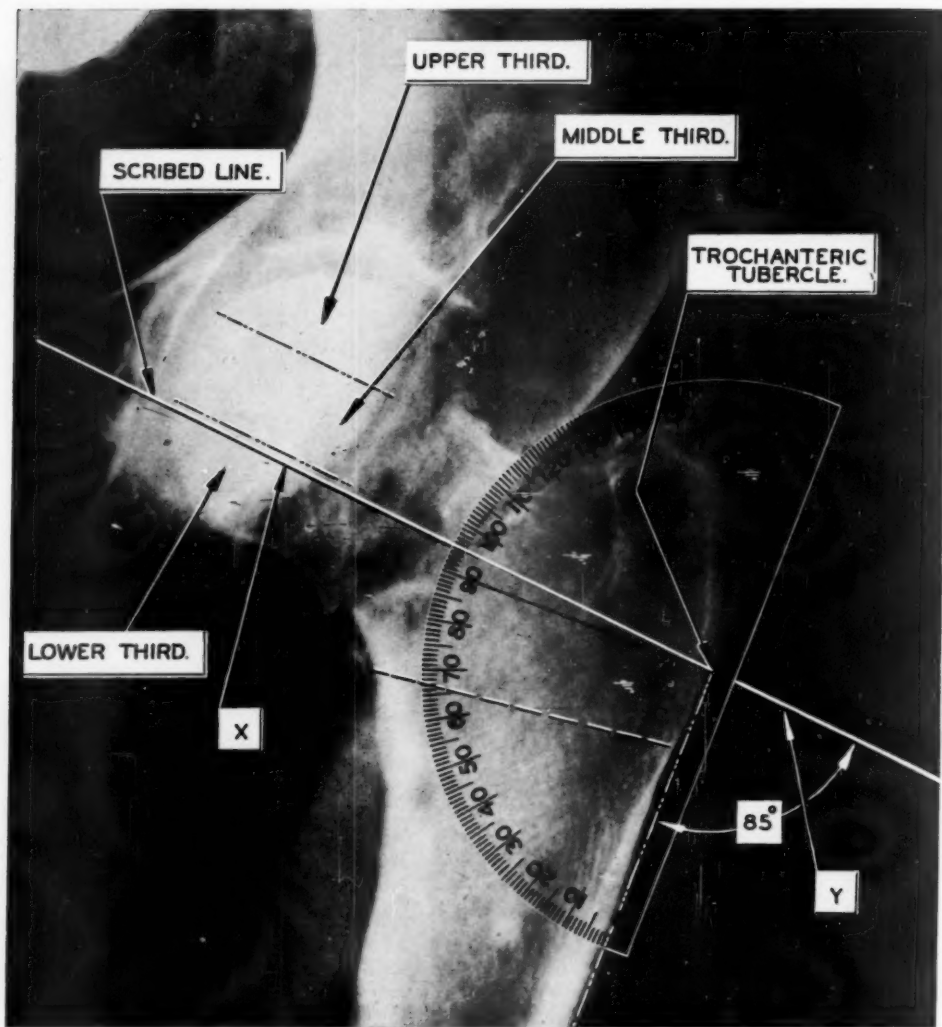


FIG. XV: The scribed line XY (too low) on the wet film is shown and this forms, with the lateral surfaces of the femur, a neck-shaft angle of  $95^\circ$ ; the angle varies from  $90^\circ$  -  $105^\circ$ .

(c) *Function when non-union of the fracture results.*

"The beauty of the whole procedure, however, is that should union not occur, the patient is still assured of a satisfactory hip." (Dawkins, 1940.) "The osteotomy still succeeds because it provides an excellent arthroplasty." (Watson-Jones, 1943.) Putti (1942) stated that there was "decided im-

provement in function." This appears to be the conviction of most authors, but, unfortunately, it is not in accordance with my experience in the 50 recent and 24 old or ununited fractures treated by osteotomy, as shown in columns C and D, Table 1. Whenever there was non-union of the fracture after an osteotomy, the functional result was either poor or bad. It was poor if there was non-union, although there might not be

any shearing of the femoral shaft and trochanter through (in front and above) the fracture. These patients had pain in the pseudarthrosis. Pain was not cured by the removal of the nail and plate when the nail had cut through the head and lay above the acetabulum. Function was bad if there was shearing as well as pain, because there was a Trendelenberg lurch and weakness (Figs. V-VII). Bone union of the fracture, as well as the osteotomy, appears to me to be essential for good function. Furthermore, in the last fifteen years I have seen patients

(d) *Prolongation of operation by osteotomy favours shock and infection of the wound.*

No greater shock has been noted than in nailing. Blood transfusions were not necessary. The operating time was increased by half-an-hour because of the division of the bone by a saw, the attachment of the plate to the femur and the longer incision that has to be sutured. The long incision introduces the danger of infection, but in this series of 50 patients, there has been only one instance. All, however, were treated

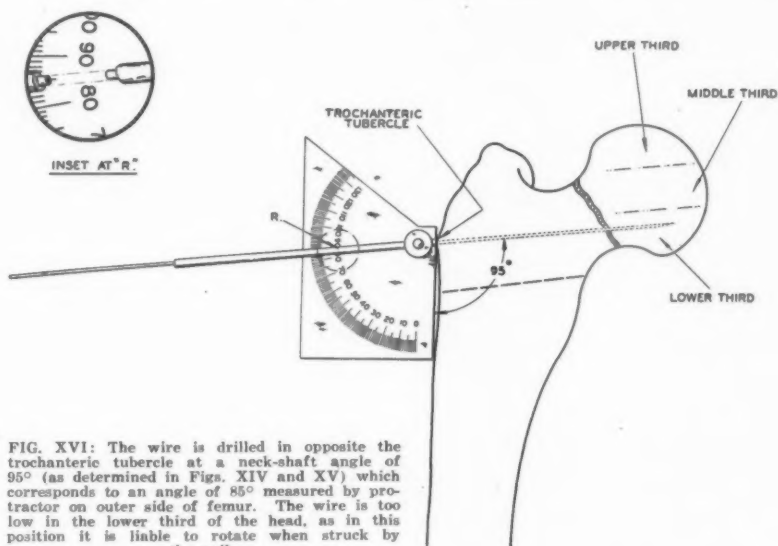


FIG. XVI: The wire is drilled in opposite the trochanteric tubercle at a neck-shaft angle of  $95^\circ$  (as determined in Figs. XIV and XV) which corresponds to an angle of  $85^\circ$  measured by protractor on outer side of femur. The wire is too low in the lower third of the head, as in this position it is liable to rotate when struck by the nail.

who have had osteotomies for ununited fractures (but without internal fixation) performed by other surgeons as well as myself, and if they were left with non-union of the fracture after the osteotomy, the functional result was always unsatisfactory. McMurray (1936), in his detailed end results of osteotomies on 27 patients for non-union did not, unfortunately, supply the essential evidence about the frequency of bone union of the fracture. In his paper, out of four sets of skiagrams of four hips operated upon, two show non-union and a third was an admitted failure; only one bone union.

with full saturation by penicillin and sulpha drugs, in the same way as compound fractures.

#### SPECIAL FEATURES OF THE OPERATION.

These are mainly shown in the illustrations and legends.

#### *Direction of the nail in the femoral head.*

The nail should enter the trochanteric tubercle at a neck-shaft angle between  $90^\circ$  and  $105^\circ$ . No alteration in the angle by bending is then required unless there is coxa vara or valga caused by under- or over-traction respectively. In the simple nailing



operation the nail is  $3\frac{1}{2}$  inches long because it is inserted obliquely at  $130^\circ$ , but for the operation of primary osteotomy and internal fixation, the nail is shorter:  $2\frac{3}{4}$  inches to  $3\frac{1}{4}$  inches. The nail is directed into the lower half (nail lying near the calcar femoralis) of the globular and expanded head of the femur because (Fig. XVII):—

(1) It should not go into the lower third, as this may cause the head to rotate into the valgus position. After the plate is attached to the nail and the osteotomy performed, it is used to maintain strong adduction of the proximal osteotomised components. This encourages the nail to plough upwards through the bone of the head, especially if the nail was placed in the middle or upper part of the head.

A few surgeons have trouble with this plate because the nail is not inserted into the lower half of the head at angles between  $90^\circ$  -  $105^\circ$ . Then they begin to bend the plate so that it soon becomes battered and twisted. If an attempt is made to bend a plate without removing it from the tapered nail-head (Fig. XIX), it is likely to bend at any part except at the angle. The nail should be inserted into the posterior half of the femoral head. It is a grave error to place the nail in the anterior half, because the strong external rotating force in the lower limb tends to make the nail cut through the bone on the front aspect of the head. Control by X-ray examination should always be done after the nail has been inserted, because occasionally the head rotates when struck

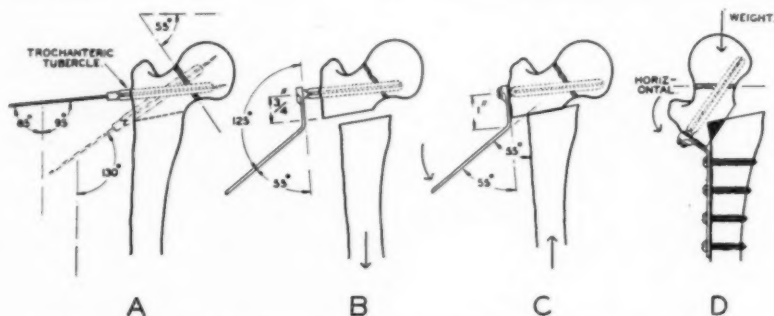


FIG. XVII: Illustrating the conversion of a  $55^\circ$  fracture line (Pauwels) into a horizontal one by a  $125^\circ$  angled plate.

- A. The nail is not inserted at the usual neck-shaft angle of  $135^\circ$  as for simple nailing (lower nail), but at a  $95^\circ$  neck-shaft angle and opposite the trochanteric tubercle.
- B. The plate is attached before the nail is driven in fully; the osteotomy is  $\frac{1}{4}$  inch proximal to the angle of the plate.
- C. Traction is released, and this permits adduction through  $55^\circ$  of the upper fragment and medial displacement of the femoral shaft.
- D. Operation completed; adduction plus pushing of the foot by an assistant causes impaction at the osteotomy site.

(2) The upper end of the plate fits the tapered nail-head at  $90^\circ$  to the long axis of the nail. If the nail is inserted at  $90^\circ$  -  $105^\circ$  (neck-shaft angle), the upper or short part of the plate will lie flat on the outer side of the femoral shaft. The standard angle of  $125^\circ$  between the upper and lower portion of the plate was found after study and a correctly adducted position of the upper osteotomised segments can then be relied upon after the plate is screwed to the femur, because the fracture site becomes almost horizontal and the angulated osteotomised site is pressing against the lateral pelvic wall.

by the nail, especially if there is over-traction. If three Kirschner wires are used to "fix" the head, this error can be avoided. As every surgeon has his own method of inserting the nail in the lateral plane, none is described in this paper.

#### *Nailing, attachment of plate, osteotomy and adduction of the head and neck.*

The nail must not be driven in completely until the plate is attached and the osteotomy performed. The nail and plate are pressed firmly together (Fig. XVIII) and the nail-holder for adduction is then attached. The

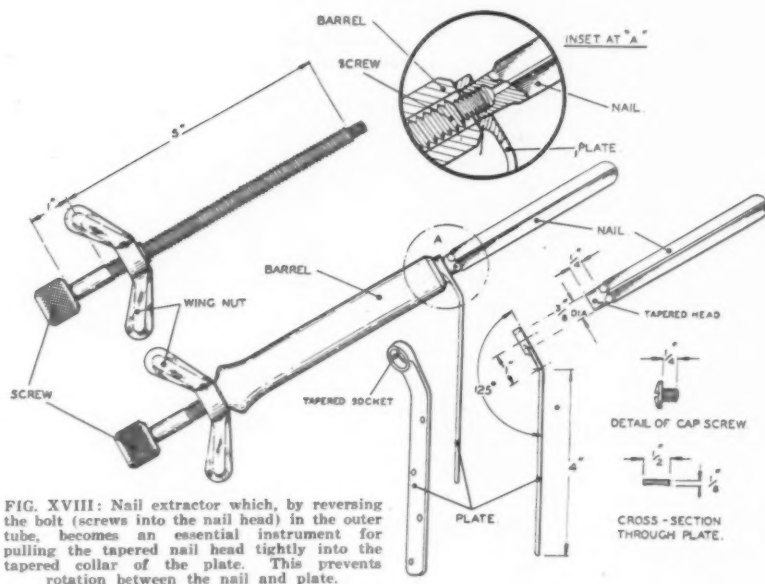


FIG. XVIII: Nail extractor which, by reversing the bolt (screws into the nail head) in the outer tube, becomes an essential instrument for pulling the tapered nail head tightly into the tapered collar of the plate. This prevents rotation between the nail and plate.

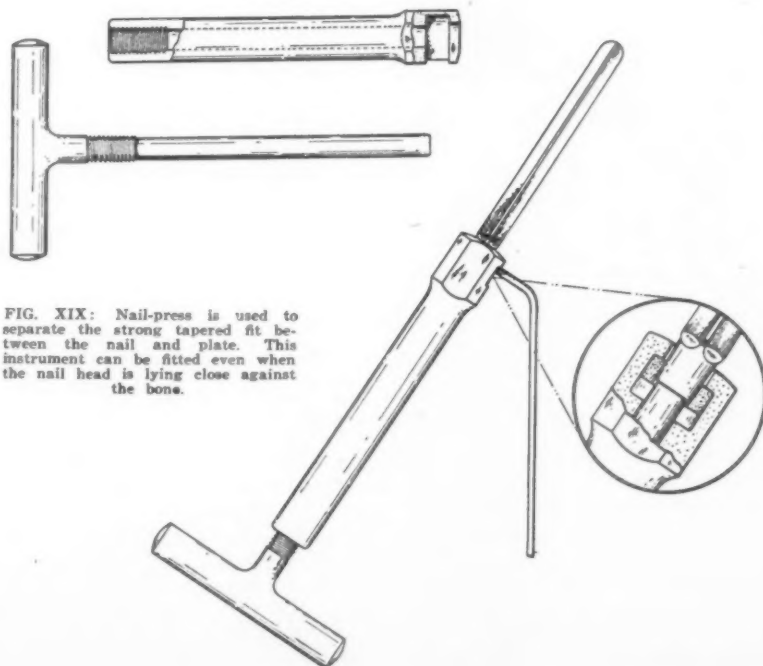
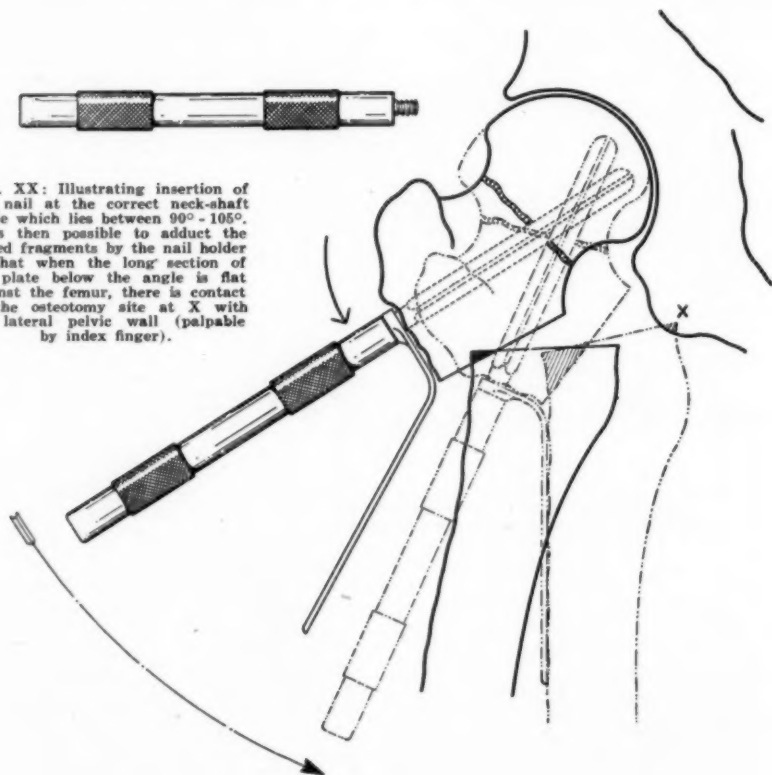


FIG. XIX: Nail-press is used to separate the strong tapered fit between the nail and plate. This instrument can be fitted even when the nail head is lying close against the bone.

osteotomy is made  $\frac{1}{4}$  inch proximal to the angle of the plate. It should not be too oblique because this causes a long spike from the calcar femoralis; this spike must be removed because it may prevent adduction of the upper fragments. After strong external rotation of the femur, the spike can be seen and should be carefully removed with a bone-nibbling forceps and not by a hammer and chisel. The nail with plate attached is now driven in. When the osteotomy is  $\frac{1}{4}$  inch proximal to the angle of the plate, the latter

tion of the femoral shaft into the trochanteric cancellous bone favours bone union of the osteotomy and brings the raw bone of the femoral shaft nearer to the fracture site. This appears to be the main reason for the success of an osteotomy for an old or ununited fracture. The upper osteotomised components are adducted with the handle (Fig. XX), and if the angle of insertion of the nail is correct, it will be found that the plate now lies flat against the outer surface of the femoral shaft distal to the osteotomy.

FIG. XX: Illustrating insertion of the nail at the correct neck-shaft angle which lies between  $90^{\circ}$  -  $105^{\circ}$ . It is then possible to adduct the nailed fragments by the nail holder so that when the long section of the plate below the angle is flat against the femur, there is contact of the osteotomy site at X with the lateral pelvic wall (palpable by index finger).



pushes the femoral shaft medially when the upper fragment is adducted. At this stage the legs should be made parallel (adducted). Traction is now removed because adduction of the upper fragment is then easier to obtain. This allows impaction of the femoral shaft into the soft bone at the base of the trochanter by an assistant pushing on the foot-piece of the traction table. This impac-

A Lowman's clamp is used to hold the plate against the femoral shaft, and this maintains the adducted position of the proximal osteotomised neck and head of the femur. A control X-ray examination, with the legs parallel and both adductor regions in contact, is now made. If the X-ray examination is satisfactory, the limbs are then abducted and the plate screwed to the bone. Patients become

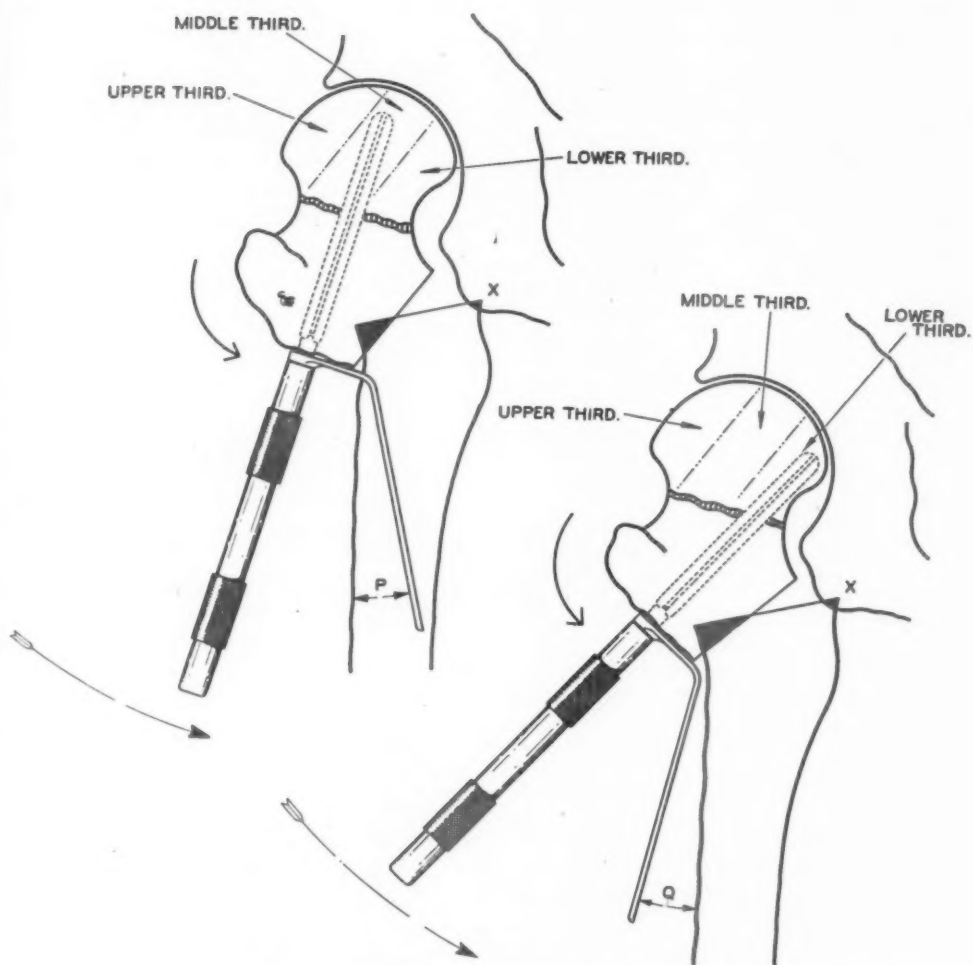


FIG. XXI: Illustrating a simple "trial and error" method for finding the correct angle of the plate when the nail has been misdirected. The plate and nail combination is designed so that if the nail is inserted from the trochanteric tubercle into the lower half of the femoral head, the short length (1 inch) of the plate above the angle will then lie on the femur (sub-trochanteric fossa) and the long part (4 inches), below the angle, lies flat against the bone; at the same time, the osteotomy site touches X. The top drawing shows that the nail has been placed too high in the femoral head and, therefore, with full adduction and medial displacement of the femur at the osteotomy site, the plate can be displaced medially in front of the femoral shaft at operation. In a case like this, the plate should be bent so that the angle indicated by P is eliminated. The lower drawing shows that the nail has been placed too low in the femoral head and, with full adduction and medial displacement, the plate does not lie against the femur; the angle indicated by Q should be eliminated by bending the plate. The plate must be removed from the nail for bending.

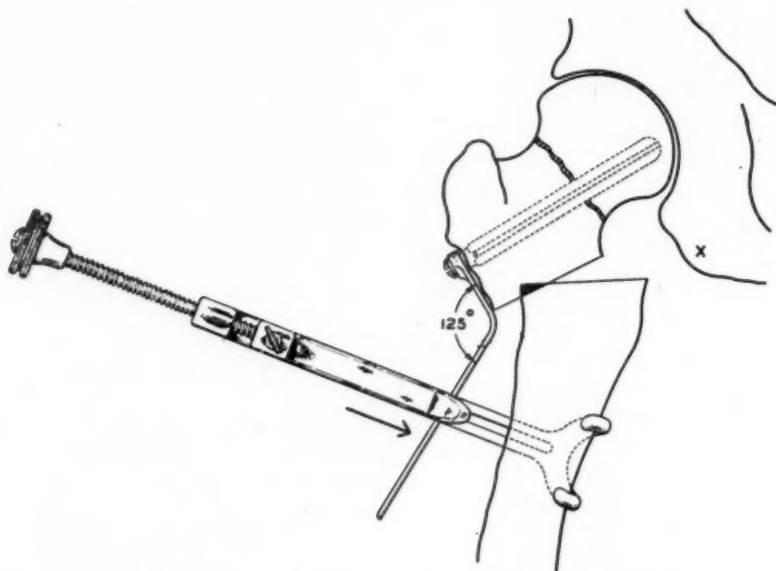


FIG. XXII: After the amount of adduction and medial displacement at the osteotomy site has been established as in Fig. XX, the upper fragment is abducted again and the nail holder is replaced by the cap screw. If the nail holder is replaced by the cap screw whilst the upper fragment is held in forcible adduction by the Lowman's clamp (Fig. XXIII), the taper joint between the nail and plate may occasionally become separated, despite the tight fit that should exist.

Fig. XXIII.  
MECHANISM OF THE OSTEOTOMY.

Favourable Factors (Red):

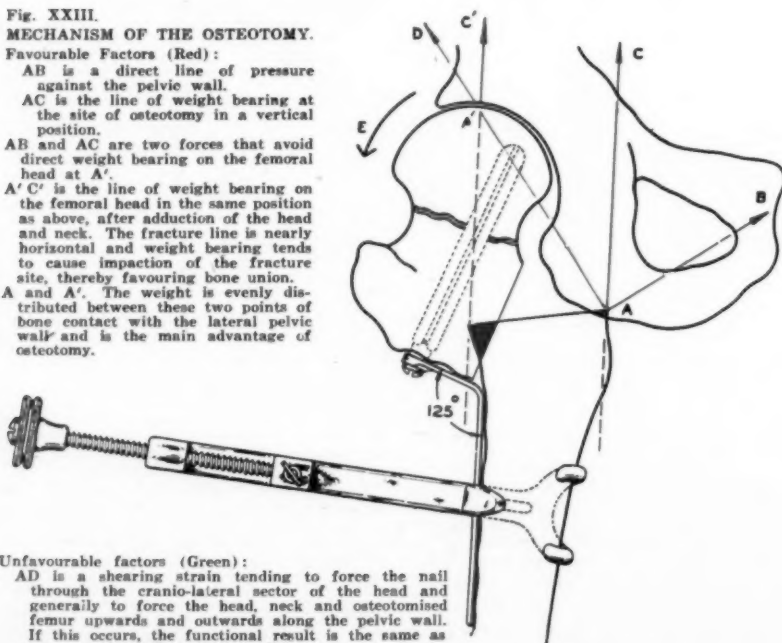
AB is a direct line of pressure against the pelvic wall.

AC is the line of weight bearing at the site of osteotomy in a vertical position.

AB and AC are two forces that avoid direct weight bearing on the femoral head at A'.

A'C' is the line of weight bearing on the femoral head in the same position as above, after adduction of the head and neck. The fracture line is nearly horizontal and weight bearing tends to cause impaction of the fracture site, thereby favouring bone union.

A and A'. The weight is evenly distributed between these two points of bone contact with the lateral pelvic wall and is the main advantage of osteotomy.



Unfavourable factors (Green):

AD is a shearing strain tending to force the nail through the cranio-lateral sector of the head and generally to force the head, neck and osteotomised femur upwards and outwards along the pelvic wall. If this occurs, the functional result is the same as in non-union after simple nailing.



ambulant in two weeks or more, but no weight-bearing is permitted until there is bone union of the fracture (four to six months) and of the osteotomy (two to three months).

#### CONCLUSIONS.

(1) There is no significant improvement in the frequency of bone union of intracapsular fractures of the femoral neck by primary osteotomy—simple nailing, 69 per cent; nailing and bone grafting, 71 per cent; primary osteotomy, 72 per cent.

(3) The advantage of primary osteotomy is that it anticipates the onset of aseptic or avascular necrosis of the femoral head, which causes the painful osteo-arthritis hip which it usually relieves. In the author's experience avascular necrosis is common after nailing (28 per cent); after nailing and grafting (42 per cent); is rare (4 per cent) after primary osteotomy. This should be confirmed by others before satisfactory conclusions are drawn; and perhaps the end results over a longer period should be studied.

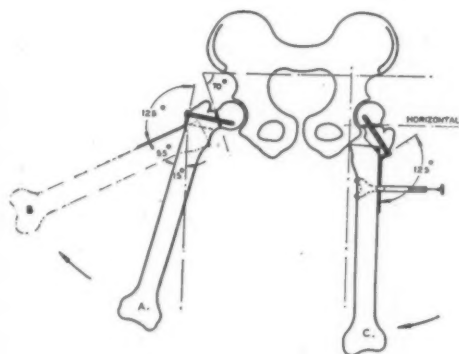


FIG. XXIV: Illustrating a correct osteotomy with a standard 125° plate and nail at 95° neck-shaft angle: the osteotomy site is in contact with the pelvic wall when the leg (C) is parallel with the long axis of the body (both adductor regions touching on the orthopaedic table). If the osteotomy site is in contact with the lateral pelvic wall when the limb is slightly abducted (15°), as in the normal walking position, there is a genu valgum disability (Fig. XXV).

A. is the normal walking position of 15° abduction and is the position of the limbs on the orthopaedic table, and in this position the fracture line is 70° to the line between the anterior superior iliac spines.

B. is the position of wide abduction ( $55^\circ + 15^\circ = 70^\circ$ ) on the orthopaedic table to permit clamping the plate to the femur.

C. is the position of the leg in the long axis of the body (parallel legs). The upper fragment has not only been adducted  $55^\circ$  by the plate, but also the limb as a whole has been adducted  $70^\circ$ ; thereby the  $70^\circ$  fracture line, measured in the  $15^\circ$  abducted position, has been converted into a horizontal line.

(2) Function after non-union of the fracture is just as bad when it occurs after an osteotomy as after simple nailing.

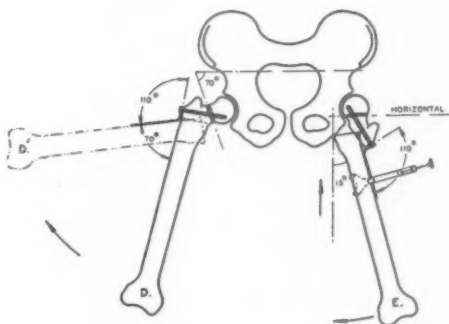


FIG. XXV: The osteotomy is incorrect because the plate was bent to a  $110^\circ$  angle. When the femur is fully adducted and the osteotomy site is in contact with the lateral pelvic wall, the limb is still abducted to  $15^\circ$ : genu valgum exists and there is a tendency to bend the plate at the angle (position E).

(4) In the 50 patients reported on, primary osteotomy did not introduce any important complications as compared with simple nailing. The possible dangers are non-union of the osteotomy, more operative technical errors, shock, infection, genu valgum, post-operative breaking or bending of faulty plates.

(5) Special indications for primary osteotomy in addition to nailing are failure to reduce the fracture, rotation of the femoral head and comminution of the neck.

(6) The technique of primary osteotomy with internal fixation by a special nail and plate is described.

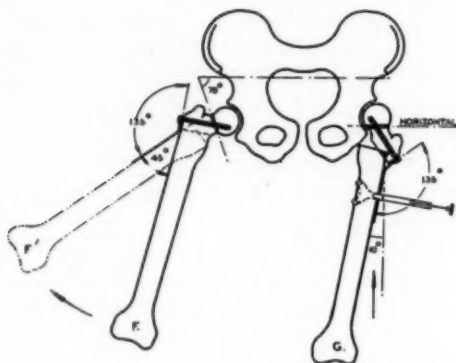


FIG. XXVI: Incorrect osteotomy because the plate has been bent to a  $135^\circ$  angle. Position G shows that there is contact with the lateral pelvic wall only when there is  $10^\circ$  abduction. Reducing the angle by  $10^\circ$  to  $125^\circ$  by bending, corrects this.

(7) This method is a valuable resource for ununited fractures.

(8) It is unlikely that primary osteotomy can replace straightforward internal fixation with a Smith-Petersen nail for recent fractures if the observations described in this paper are confirmed by others.

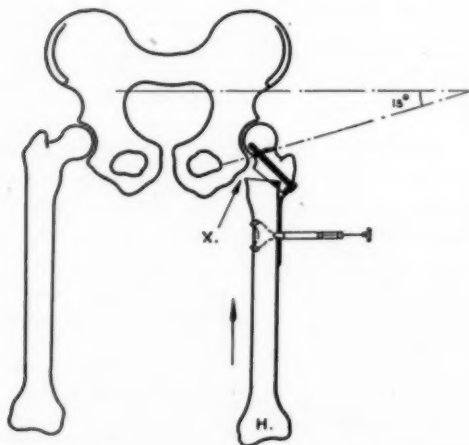


FIG. XXVII: Incorrect osteotomy (same as Fig. XXVI but shows the effect of weight bearing with parallel legs). There is no pressure against the pelvic wall by the osteotomised femur. The full weight is taken as usual through the head at its cranio-lateral sector. With the normal position of  $15^\circ$  abduction for weight bearing, there would be still further separation at X from the pelvic wall. Bending the plate to  $125^\circ$  corrects this.

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TABLE 1.

Comparison of consecutive results in recent intra-capsular fractures of (A) simple nailing; (B) nailing plus fibular graft; (C) primary sub-trochanteric osteotomy with nail and plate fixation; and (D) old (over six weeks) ununited fractures of the femoral neck treated by osteotomy with nail and plate fixation.

	A Recent fractures  Simple nailing (100 patients)	B Recent fractures  Combined nail and bone graft (31 patients)	C Recent fractures  Osteotomy, nail and plate (50 patients)	D Old fractures (6 weeks to 12 months duration) Osteotomy, nail and plate (24 patients)
Bone union of fracture	69 (69%)	22 (71%)	36 (72%)	19 (79.2%)
Non-union of fracture	17 (17%)	3 (9.7%)	9 (18%)	4 (16.7%)
Death .. .. .	14 (14%)	6 (19.3%)	5 (10%)	1 (4.2%)
Infected wound ..	4 (4%)	3 (9.7%)	1 (2%)	None
Aseptic necrosis of head of femur .. .. .	28 (28%)	13 (42%)	2 (4%)	Operation not per- formed if head of femur deformed.
Non-union of osteotomy	—	—	None	None



TABLE 2 (continued)

No.	Age	Pre-operative complications	Date of fracture	Date of operation	Bone union of Osteotomy	Bone union of Fracture	Aseptic Necrosis	Function: Normal: None, Good: No pain, walks well. Fair: Occa- sional pain, walks well. Poor: Constant pain after short walk. Bad: Pain pre- vents walking	Date of last examination
35	53	Cardiac failure	Apr. 14th, 1948	May 12th	Yes	Yes	No	Good	Oct. 16th, 1949
36	68		May 25th, 1948	May 26th	Yes	Yes	No	Good	Feb. 10th, 1949
37	72		July 14th, 1948	July 21st	Yes	Yes	Slight	Fair	Nov. 6th, 1948
38	85		July 26th, 1944	Aug. 4th, 1948	—	—	—	Death :	Oct. 17th, 1948
39	43	Rheumatoid arthritis	Aug. 1st, 1948	Aug. 9th	Yes	Yes	No	Good	Mar. 3rd, 1949
40	76		Aug. 5th, 1948	Aug. 9th	Yes	Yes	No	Good	Jan. 16th, 1949
41	59		Aug. 5th, 1948	Aug. 9th	Yes	Yes	No	Fair	Apr. 8th, 1949
42	70		Aug. 7th, 1948	Aug. 23rd	Yes	Yes	No	Fair	Apr. 4th, 1949
43	70		July 21st, 1948	Aug. 23rd	Yes	Yes	No	Good	June 16th, 1949
44	65		July 28th, 1948	Aug. 30th	Yes	Yes	No	Good	Sept. 5th, 1949
45	63	Diabetes	Aug. 28th, 1948	Sept. 6th	Yes	Yes	No	Fair	Oct. 30th, 1949
46	59		Aug. 11th, 1948	Sept. 11th	Yes	Yes	No	Good	Oct. 11th, 1949
47	54		Oct. 23rd, 1948	Nov. 7th	Yes	Yes	No	Good	Oct. 27th, 1949
48	53	Diabetes	Nov. 2nd, 1948	Nov. 20th	Yes	Yes	No	Good	Oct. 27th, 1949
49	59		Nov. 29th, 1948	Dec. 13th	Yes	Yes	No	Good	Oct. 27th, 1949
50	84	Rheumatoid arthritis	Dec. 5th, 1948	Dec. 13th	Yes	Yes	No	Good	Oct. 30th, 1949



TABLE 3.  
RESULTS OF COMBINED NAILING AND BONE GRAFTING OF 31 CONSECUTIVE  
RECENT (UNDER 4 WEEKS) INTRACAPSULAR FRACTURES OF THE FEMORAL NECK.

No.	Age	Date of operation	Bone union	Aseptic necrosis when bone union present	Function	Date of re-examination
1	68	May 15th, 1938	Yes	Yes	Good	1943
2	76	July 8th, 1938	Yes	No	Good	Apr. 15th, 1940
3	67	July 28th, 1938	Yes	Yes	Bad	Died: Septic arthritis Apr. 1st, 1939
4	52	Aug. 18th, 1938	Yes	Yes	Bad	Osteotomy for pain Oct. 23rd, 1942
5	72	Aug. 31st, 1938	—	—	—	Death: Sept. 14th, 1938
6	70	Aug. 31st, 1938	Yes	Yes	Fair	Mar. 1st, 1939
7	73	Sept. 7th, 1938	No	—	Bad	Nov. 28th, 1938
8	74	Oct. 5th, 1938	No	—	Poor	July 7th, 1941
9	74	Oct. 18th, 1938	Yes	Yes	Fair	Feb. 3rd, 1939
10	65	Nov. 16th, 1938	Yes	No	Fair	May 18th, 1939
11	65	Nov. 30th, 1938	Yes	No	Fair	May 8th, 1939
12	70	Dec. 14th, 1938	—	—	—	Death: Dec. 27th, 1938
13	79	Dec. 30th, 1938	—	—	—	Death: Jan. 14th, 1939
14	75	Jan. 13th, 1939	Yes	Yes	Fair	Aug. 12th, 1939
15	72	Jan. 18th, 1939	—	—	—	Death: Feb. 22nd, 1939
16	24	Jan. 18th, 1939	Yes	No	Good	Feb. 18th, 1940
17	80	Mar. 18th, 1939	Yes	No	Good	Feb. 15th, 1940
18	63	Apr. 3rd, 1939	Yes	No	Good	1941
19	76	Apr. 14th, 1939	Yes	No	Good	Aug. 18th, 1948
20	74	Apr. 27th, 1939	—	—	—	Death: Apr. 30th, 1939
21	54	May 9th, 1939	Yes	Yes	Fair	Nov. 17th, 1942
22	70	May 19th, 1939	Yes	Yes	Fair	Jan. 13th, 1941
23	73	May 30th, 1939	Yes	No	Good	June 19th, 1948
24	73	June 6th, 1939	Yes	Yes	Bad	Septic arthritis—Bone ankylosis Mar. 24th, 1943
25	71	June 7th, 1939	Yes	No	Fair	Dec. 11th, 1939
26	65	July 28th, 1939	—	—	—	Death: July 29th, 1939
27	71	Oct. 21st, 1939	No	—	Poor	May 23rd, 1940
28	68	Dec. 12th, 1939	Yes	Yes	Fair	Feb. 20th, 1941
29	67	May 23rd, 1940	Yes	Yes	Poor	Mar. 19th, 1943
30	61	May 24th, 1940	Yes	Yes	Fair	Sept. 11th, 1941
31	71	Sept. 17th, 1942	Yes	Yes	Fair	Septic arthritis— Bone ankylosis Dec. 1st, 1944

TABLE 4.  
SUMMARY OF NON-UNIONS AFTER 295 SUB-TROCHANTERIC OSTEOTOMIES.

Number	Indication for osteotomy	Post-operative splinting	Non-union of osteotomy
110	Painful hip-osteoarthritis, ununited fracture, etc.	Traction and sling	4
30	Painful hip-osteoarthritis, ununited fracture, etc.	Plaster spica	3
80	Painful hip-osteoarthritis, ununited fracture, etc.	Nail and plate	1 (1.25%)
75	Recent intracapsular fracture	Nail and plate	0

*Comment:* The McMurray osteotomy is liable to delayed union and non-union if the femoral shaft is displaced too far medially when the bone division has been transverse instead of oblique, especially if the upper osteotomised component is not adducted as it is always in the low or Schanz osteotomy. Most surgeons complain about this. There were 7 non-unions out of 140 operations when external fixation was used, but only 1 out of 155 with internal fixation. Of the 8 non-unions, 6 were after the McMurray osteotomy and 2 after the Schanz variety, although more than half of the operations were of the latter type.

TABLE 5.

SUMMARY OF INFECTED WOUNDS FOLLOWING 615 OPERATIONS ON THE HIP  
IN WHICH INTERNAL FIXATION WAS EMPLOYED.

Number	Type of operation and indications	Infected wounds
325	Nailing recent intracapsular fractures .. .. .	6 (1·8%)
31	Nailing and grafting recent intracapsular fractures .. .. .	3 (9·7%)
80	Nailing and plating recent extracapsular fractures .. .. .	3 (3·8%)
80	Osteotomy, nailing and plating for osteoarthritis .. .. .	2 (2·5%)
24	Osteotomy, nailing and plating for ununited intracapsular fractures ..	0
75	Osteotomy, nailing and plating for recent intracapsular fractures ..	1 (1·3%)

*Comment:* The nail-graft and extracapsular fracture operations that became infected were in the pre-penicillin period. The 75 primary osteotomy patients—details of only the first 50 consecutive operations are in Table 2—had penicillin pre- and post-operatively.

## PRIMARY UNILATERAL HARE LIP REPAIR

By K. B. FRASER

*Brisbane*

### INTRODUCTION.

**S**URGEONS attached to special centres in countries of dense population have the advantage of working in close association with colleagues with whom they can discuss the minutiae of surgical technique and the pros and cons of the surgical procedure to be adopted in any given case.

In Australia, and particularly in the more sparsely populated States, the position is very different. The number of cases in any specialised branch of surgery is of necessity limited and the surgeon often has to blaze his own trail relying only on his reading, on his periodic visits to other centres and on his slowly developing experience.

For this reason it is most important to evaluate results by a careful follow-up of all cases, for only in this way can faults be uncovered and technique improved to eliminate them.

Since resuming work after the war I have operated, in all, on 136 hare lip and cleft palate cases, of which 103 were primary operations. Of this number 60 were primary lip operations and of these again 45 were primary unilateral lip operations.

These 45 primary unilateral repairs have been subjected to critical review on which the opinions expressed in the present paper are based.

### THE TIME TO OPERATE.

I now tend to wait a little longer than previously. No baby in this series was operated on before it weighed ten pounds, even if this meant waiting until it was three months of age. If possible, however, it is most desirable to operate before the fourteenth week as I am sure signs of surgical interference are more obvious if operation is delayed longer than this. Also if one waits longer than this in cases where the premaxilla and maxilla are widely separated, the repaired lip will not mould the underlying bone sufficiently to close the gap.

Before operation is thought of care is taken to see that the baby is free from any skin, respiratory or alimentary tract infection.

### THE PRE-OPERATIVE TREATMENT.

From birth if possible, but certainly from the time of admission to hospital, all those in attendance on the baby are masked.

With an intact palate a hare lip does not necessarily interfere with breast or bottle feeding and this is continued where possible until a few days before operation when pipette feeding is instituted, but every effort is made to maintain the supply of breast milk as long as possible.

A pre-operative transfusion of approximately 100 c.c. blood is given twenty-four hours before operation in nearly all cases. The value of this is not only to have the haemoglobin value at a satisfactory level before operation, but to ensure that the post-operative oxygen carrying capacity of the blood is at least at as high a level as it was on entry to hospital. I am satisfied that this transfusion definitely lessens post-operative shock. The blood is injected into the vein at the rate of 7.5 c.c. per minute and no untoward reactions have been encountered.

Penicillin in appropriate dosage is commenced twenty-four hours before operation.

### THE ANAESTHETIC.

The type of anaesthetic depends largely on the facilities available. It has been found that intrapharyngeal ether, with the addition of oxygen when required, is quite satisfactory. A curved tongue clip, with a tube attached, is clipped well back on the tongue and does not interfere with the operative field.

One case of oedema of the glottis occurred necessitating tracheotomy. It was thought that this was due to irritation by a catheter passed through the nose and impinging on the posterior pharyngeal wall.

The only death in the series was an anaesthetic one, which occurred suddenly four minutes after the operation had commenced. At the post-mortem examination no light was thrown on the cause of death. The child was an aboriginal girl aged eighteen months, and as a result of experience over the years there is a very definite feeling at the Brisbane Children's Hospital that aboriginal children are very much worse anaesthetic risks than white children.

#### THE RATIONALE OF THE OPERATION.

To undertake a unilateral hare lip repair one must have always in mind the stigmata of this embryological cleft. Although the gap in the lip is the obvious defect, the greatest surgical difficulty in the operation is to overcome the nasal deformities: in a classical case these nasal deformities are:—

i. The columella at its base is dragged across to the sound side.

ii. The ala on the affected side is depressed, in other words as it leaves the columella it does not maintain the same height as the ala on the opposite side and it gives the impression that an invisible thumb is crushing it down.

iii. The attachment of the involved ala to the cheek is posterior to its neighbour.

iv. This alar attachment is also lower on the face than normal.

v. The involved ala at its base does not curl inwards so as to meet the cheek at an acute angle. In extreme cases it does not turn in at all and continuing outwards, meets the cheek at an obtuse angle.

vi. The involved ala is often longer than its fellow.

vii. The cartilaginous wall of the involved ala is everted so that the surface which is normally invisible inside the nostril is very clearly seen.

The repair then concerns, firstly the correction of these nasal deformities and the provision of a good nostril wall and floor, and secondly a satisfactory union of the two component parts of the lip.

In discussing the lip I find that the nomenclature is often misleading. It is best to think of the lip as (a) the lip proper ex-

tending from the base of the nose to the muco-cutaneous line, with its anterior skin surface and its deep mucosal surface and (b) the red mucosal surface—alternatively known as "red mucosa" or "vermilion"—passing from the muco-cutaneous line down to the free border of the lip and then curving round out of sight to become continuous above with the mucosa on the deep surface of the lip proper.

The aims as far as the lip is concerned are:—

i. A hair-line scar without stitch marks.

ii. A mobile upper lip in advance of the lower with a tendency to concavity from above downwards, the well known "flexion curve" of infancy.

iii. An even and symmetrical muco-cutaneous line.

iv. A full, smooth and symmetrical red mucosa.

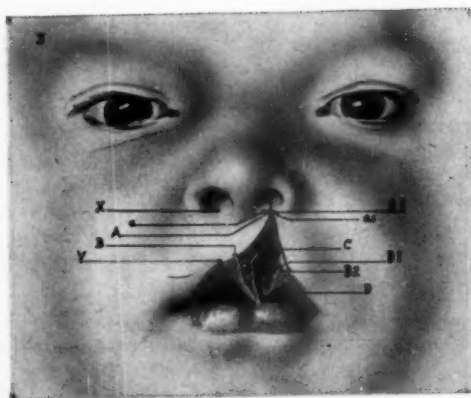
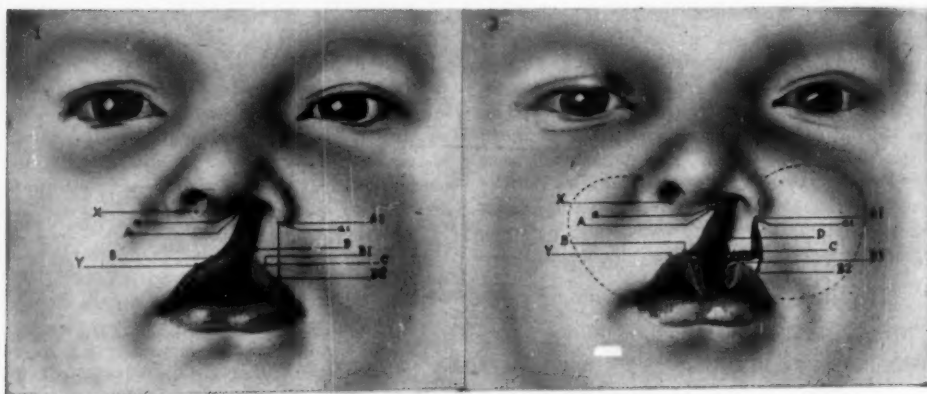
v. A deep buccal sulcus.

It is of the utmost importance that the initial repair should result in a good nose, and in a lip which is symmetrical and mobile, with minimal scarring, for if this is the case any subsequent minor repairs present no difficulty.

It is, however, a very different proposition if one has to carry out a secondary plastic operation in a case which has been badly repaired at the original operation leaving a grossly distorted nose and lip. Secondary repairs on these cases are nearly always relatively disappointing however skilled the surgeon may be.

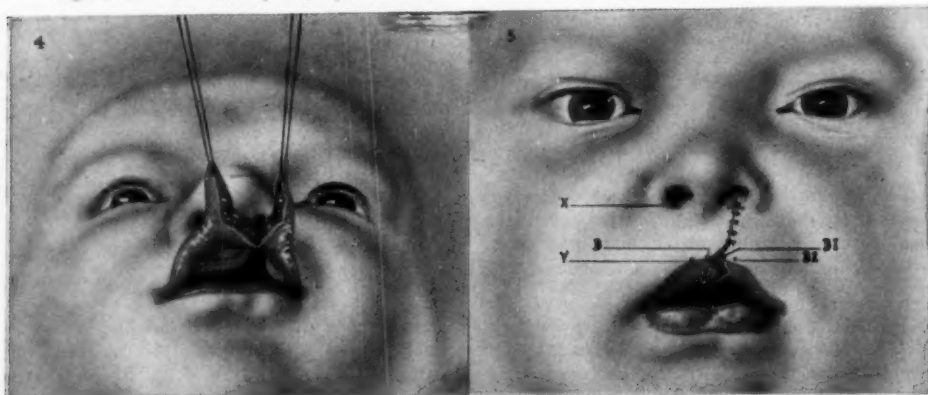
#### TECHNIQUE OF THE OPERATION.

While the operation for double hare lip is at best a matter of making both ends meet, and allows of very few refinements, the operation for unilateral hare lip can be in its way a work of art and demands of the surgeon a high degree of skill and judgment. Of all the techniques I have seen or read about, that described first by Vilray Blair of St. Louis and subsequently elaborated by Barrett Brown and McDowall has for many years seemed to me to be the one which is best adapted to overcome the existing deformities. I have followed their basic teach-



Figs. I-IV — For description, refer to text.

Drawn by S. Aubrey-Croft 49





ing for many years but from time to time have made quite a number of modifications of my own to suit my own particular difficulties and shortcomings.

The method employed in doing a complete unilateral repair of moderate severity will be described, as the other types of unilateral lip cleft can be dealt with by simply modifying the technique to suit the individual case.

It might, with advantage, be stressed at this stage that almost every incomplete lip cleft has the same nasal deformities as the complete ones. It is, therefore, necessary at operation to convert the incomplete cleft into a complete one before proceeding with the usual dissection. In these cases of incomplete cleft the technique varies in minor details only.

With a small pad under the shoulders and the head tilted slightly back, the operator stands at the right side of the patient rather than in the position at the head of the table which is in vogue in many overseas clinics. When standing on the right side the surgeon can, if he wishes, quickly get an upside down view of the patient's face by moving his head across and to the top of the table.

The mouth is lightly packed with gauze which is changed from time to time as required. This gauze together with the use of a sucker prevents the accumulation of blood in the pharynx.

As it is notoriously difficult to explain the detailed technique except in the operating theatre, sketches were made in the theatre and subsequently converted into coloured drawings.

#### STAGE 1. MARKING THE FLAPS AND INJECTING THE CHEEKS.

(Fig. 1)

A point X is selected in the centre of the floor of the sound nostril. The lip on the columellar side of the cleft is pushed across towards the mid-line and a point Y is marked on the muco-cutaneous line vertically beneath X.

A point A on the cleft side of the columella is marked which corresponds to X in its relationship to the columella. Just on the columellar side of this a second mark a is made.

A<sup>1</sup> on the alar side of the cleft is marked so that it bears the same relationship to the alar base on the cleft side that X bears to the alar base on the sound side. Sometimes it is helpful to push the affected alar base towards the mid-line so that A<sup>1</sup> can be accurately gauged. Correct location of this point is very important as it determines not only a correct level of the ala but also plays a big part in the correct "in-turn" of the alar base and helps to overcome the eversion of the alar cartilage. Then a mark a<sup>1</sup> is made just lateral to A<sup>1</sup>.

The marks a and a<sup>1</sup> are made to act as guides in case A and A<sup>1</sup> are lost in the subsequent dissection.

B is marked on the muco-cutaneous line so that  $AB = XY$ . If this point B is found to be at a spot where the red mucosa, as the latter sweeps down from the top of the cleft, has not yet attained its full thickness, AB must be extended until B lies at a point where the full thickness of the red mucosa is reached. A check can be made on this question of red mucosa thickness by looking at the lip from the top of the table.

On the alar side of the cleft, B<sup>2</sup> is then marked on the muco-cutaneous line so that  $AB^2 = AB$ . On the same side B<sup>1</sup> is marked on the muco-cutaneous line just where the red mucosa begins to narrow as it sweeps upward. Now a point C is made on AB<sup>2</sup> so that  $B^2C = B^1C$ .

It will be seen that  $AB = A^1CB^1$  and it is along these lines that incisions will be made. D is the point where the red mucosa fades out on the alar side of the cleft.

The retention of the tissue lying between the line B<sup>1</sup>CB<sup>2</sup> and the muco-cutaneous line helps to give the necessary fullness to the free border of the lip.

One per cent Novocain solution with two minims of adrenalin to the ounce is now injected through the buccal sulcus well into the cheek and particularly round the infra-orbital nerve on each side, this minimises haemorrhage and lessens painful stimuli. At this point when the operation is about to commence not more than twenty minutes should have elapsed since the commencement of the anaesthetic and the operation should if possible be completed in forty-five minutes after this.

## STAGE II. MOBILISING THE SOFT TISSUES.

On each side an incision is made along the fornix of the buccal sulcus and the cheek is dissected freely off the maxilla. The dissection is carried well back to the buccal pad of fat and upwards and outwards towards the infraorbital ridge and the zygomatic arch, being careful to preserve the infraorbital nerve and to keep close to the bone to avoid branches of the facial nerve: in one case in this series there was slight damage to the facial nerve. The alae both on the cleft side and on the sound side are boldly dissected off the bony edge of the pyriform fossa and the fibrous septum at the base of the columella is dissected freely off the bone. On each side, well back, a nick is made in the free edge of mucosa where the cheek has been lifted off the maxilla.

Inside the affected nostril on the cleft side the medial extremity of the incision is carried up at right angles towards the tip of the inferior turbinate bone.

The ultimate success of the operation depends primarily on making this dissection very radical, more radical indeed than at first sight seems necessary.

## STAGE III. CUTTING THE FLAPS.

(Fig. II)

During this manoeuvre haemorrhage is limited by the use of lip clamps.

An incision is made through the lip along the line AB with a Denis Browne chisel. A temporary suture is passed through the tip of the mucosal flap thus reflected, and in making this incision through the full thickness of the lip care must be taken to keep the chisel in a plane at right angles to that of the lip.

On the alar side of the cleft, using a narrow bladed knife and again working carefully at right angles to the plane of the lip, an incision is made from B' to D through the full thickness of the lip along the mucocutaneous line. Again a temporary suture is passed through the tip of the mucosal flap thus made. Then an incision is made through the full thickness of the cheek along the line A' C B'.

The flap of skin now lying free and based on the skin in the region of the alar base is

known as the nasal flap. In making this incision the angle at C may be turned somewhat less abruptly provided the ultimate length of the incision A' C B' is unaltered. At this stage the necessary paring is done to ensure that the edges of the mucosal flaps contain no skin strips and that the raw skin edges contain no mucosal strips.

## STAGE IV. FREEING THE SKIN FROM THE CARTILAGE OF THE ALA ON THE AFFECTED SIDE.

A small curved round-ended pair of dissecting scissors is now passed up between the skin and cartilage of the ala by opening and shutting the blades until the tip of the nose is reached and a wide area of skin has been dissected from the underlying cartilage. This dissection must be carried right to the rim of the ala. In this way the skin is allowed to slide round the outside of the cartilage as the ala is subsequently "in-turned" and the cartilage being thus allowed to take its own curve, unaffected by the drag of attached skin, has much less tendency to kink. This I consider is a very important step in obtaining a nostril approximating in shape to the normal side.

## STAGE V. APPROXIMATING THE EDGES OF THE CLEFT.

Before the edges AB and A' C B' are approximated the skin must be separated from the muscle and the muscle from the mucosa for a depth of 1.2 mm. along the length of each raw edge. This helps, on the one hand, to avoid a depressed skin scar and, on the other hand, to prevent inversion of the mucosal edges when they are brought together on the deep surface.

The first step in the closure of the cleft is to bring A to A' by passing a deep silk suture (size 2-0 Deknatel) through the full thickness of the lip using if necessary the points a and a' as a guide. Before this is actually tied, but while the raw edges are held close together, the nasal flap previously referred to is rotated into the nostril and sutured, with fine catgut on a fully curved eyeless needle, to a raw area prepared for its reception at the base of the septum. As much or as little of this nasal flap is used as is necessary to form a firm nostril floor.

It is remarkable how well this flap will sit into position in spite of the fact that it has been rotated through approximately  $90^\circ$  in two planes at right angles.

If the previous dissection has been adequate the points A and A' should come together without tension and the 2-0 suture is now tied. (Fig. III.) If it has been correctly placed this suture will roll the alar base into its correct position and at the same time will minimise the eversion of the alar cartilage, this eversion being one of the most difficult of all the deformities to overcome.

The two lip components are now lifted up and away from the face by the two temporary sutures to expose the deep mucosal surface. A muco-muscular vertical mattress suture is passed from the deep surface bringing the muscle and mucosa of each side together at the level of the buccal formix. (Fig. IV.) Great care must be taken to place this stitch high up; in fact, practically on the same level as the deep silk suture already tied.

One or two similar muco-muscular vertical mattress sutures are passed from the deep surface, working down the lip, but being very careful to keep well above the bases of the free mucosal flaps. These stitches if correctly placed advance the upper part of the lip so well that a mobile and everted lower part results.

One or two buried muscular sutures of fine catgut now bring the muscle together down to the level of the muco-cutaneous line. Using fine catgut no trouble is experienced with these buried sutures. The next step is approximation of the skin edges. This is done with 6-0 silk on fine eyeless needles, and the interrupted sutures are passed through skin only, the needle entering and leaving the skin close to the free edge on each side. The raw skin edges are brought into accurate apposition without actual tension, and if there is a tendency to inversion, vertical mattress, rather than simple interrupted sutures, may be used. These individual stitches must be very carefully placed so that ultimately B' will come nicely into position against B on the muco-cutaneous line. This line of sutures is, however, stopped temporarily short of this point.

At this stage attention is directed to the two mucosal flaps through the tips of which the temporary sutures were originally passed. A "V" of tissue with the apex directed laterally is cut out of the mucosal flap on the alar side and then the mucosal flap on the columellar side is trimmed so that it will fit snugly into this "V". (Fig. V.)

Occasionally the surgeon will find that the flaps lend themselves more easily to moulding in the reverse way.

Reverting to the skin suture line, the points B and B' are brought together with one or more additional 6-0 sutures. On the correct placing of these sutures will depend the evenness of the ultimate muco-cutaneous line.

The mucous surfaces, which have been fitted but not yet united, are now sutured lightly together, using silk in front and fine catgut behind; care being taken to see that no raw surface remains. To carry out this manoeuvre additional trimming of the remains of the mucosal flaps is generally necessary.

This imbrication of the two mucosal flaps to form the free lower border of the lip is the hardest part of the operation to describe and in my opinion it requires not only great care but considerable experience to get the best possible result. The completed suture line will be found to sweep downwards and medially in an even curve from the floor of the repaired nostril to the muco-cutaneous line. It will then turn downwards and laterally on the red mucosa and then downwards and medially again until it disappears from sight round the free lower border of the lip. This type of suture line is much more satisfactory than one which continues in the same direction throughout its length.

In cases where the alar fold still shows a tendency to kink or where the alar cartilage remains so everted that it is unpleasantly visible inside the newly formed nostril, improvement can be effected by passing a silk suture into the nostril and out again to be tied on the skin; the optimum position for this suture is often a matter of trial and error. The repaired nostril is then packed lightly with paraffin gauze.

A Logan's bow is applied, care being taken not to pull the lip components together so tightly that the venous return is obstructed.

The silk stitches in the skin and mucosa are all cut short, this facilitating the post-operative attention to the suture line. It is felt that any slight difficulty in the subsequent removal of such extremely fine sutures is more than repaid by the virtual absence of subsequent stitch marks.

#### THE POST-OPERATIVE TREATMENT.

1. Nursing is carried out with the baby isolated as far as possible and all attendants are masked.

2. The arms are splinted and the baby is restrained only sufficiently to prevent him turning on to his face.

3. Pipette or spoon feeding preferably with expressed breast milk is re-established as soon as feasible after recovery from the anaesthetic.

4. Parenteral penicillin is continued, 10,000 units three-hourly for four or five days.

5. The suture line is not covered with any dressing. The nursing staff is instructed to keep the suture line quite free of any exudate; this requires very frequent swabbing at first with a lengthening time interval as time goes on. Swabbing consists in gently wiping over the scar line with half-strength (100 volume) hydrogen peroxide followed by saline and then by 1-1000 monacrin solution.

6. Most of the silk stitches are taken out on the fourth day, the Logan's bow being removed for the purpose and reapplied: the gauze in the nostril is removed at the same time. The thicker silk suture uniting A and A' is sometimes left in a day or two longer as also is the fine silk stitch approximating B and B', but this depends on the particular circumstances in each case; these stitches must be taken out at the earliest possible moment but not so soon that the scar line will spread.

7. The Logan's bow comes off on the sixth day.

8. Breast, bottle or spoon feeding which ever is applicable is reinstituted as a rule on the tenth day.

#### DISCUSSION.

As previously mentioned it is harder to get a good nostril than a good lip in any except the minor grades of deformity. This nasal deformity is aggravated in extreme cases of unilateral cleft where the ala is grossly distorted and is often longer than its fellow of the opposite side due to the wide gap between the bony components, but even in these cases it is a mistake to excise any of the alar cartilage. The remedy lies in being even more radical than usual in the mobilisation of the soft tissues.

Another thing to remember is that there is an inherent tendency for the original deformities to re-establish themselves after operation, and therefore it often pays to overcorrect the columellar and alar deformities to some degree.

Nothing is more unsightly than a "V" depression in the nostril floor or a nostril floor at the wrong level and in addition every effort must be made to prevent kinking of the ala and slumping of the nostril wall on the affected side. If these deformities are avoided and if there is a good nasal floor with a well "in-turned" alar base at the correct level, then small discrepancies in the shape and size of the reconstituted nostril as compared with the sound side will not be very noticeable.

In regard to the lip, careless suturing of the deeper layers will result in a depressed scar or in a localised bulging of the lip on one or both sides of the scar line.

The skin sutures except at A - A' must be superficial, passing only through the skin and not picking up any muscle tissue and they must enter and leave the skin reasonably close to the free edge on each side. If the tension is such that the first knot requires holding when these stitches are being tied, it is an indication that there has been some fault in the technique in the preceding stages. If there is any difficulty in picking up the muco-cutaneous junction on either side, that is at B or B', it is wise to use a loupe or magnifying glass as these points must come together with mathematical exactitude.

It will be noticed that no effort is made to get a cupid's bow curve in the muco-cutaneous line. It is only in women that such a curve might be considered desirable and there are so many other more important points to be dealt with that no attempt in this direction is justified. The imbrication of the red mucosa should result in an even red surface on the free border of the lip. Often it is hard to avoid an angle on the free surface just at the base of one or other or both of the red mucosal flaps, with an associated bulge in the region of the suture line on the free mucosal surface. This is one of the easiest faults to correct later, provided that the red mucosa, from the corner of the lip to the commencement of the bulge is of adequate fullness; if, however, there is a narrowing of the mucosal surface just beside the bulge on one or other side the subsequent repair is less satisfactory. The narrowing of the red mucosa at this point is due often to the marks B and B' not being far enough out on the muco-cutaneous line.

If there is any doubt when it comes to suturing the mucosal flaps it is much wiser to leave a little too much tissue rather than not enough.

One must guard against an inverted "V" deformity, either in the muco-cutaneous line, in the free border of the lip, or in both. This is correctable but requires a more radical repair than a simple mucosal bulge.

A most unsightly and irrevocable deformity is a lip which is too long vertically and is too short and tight from side to side. It is often associated with an inverted and narrow red mucosal surface. Both defects are due to carrying the incisions A B and A' B' too far out on to the lip on each side. This latter defect will be aggravated if the knife is directed outwards when cutting the flaps, if the muco-muscular sutures on the deep surface have been continued too far down or if the mucosa on the deep surface has been inverted.

No cases of serious wound infection have occurred in the series under discussion and there is no doubt that parenteral penicillin has helped materially in bringing this to pass.

There is no doubt that the use of very fine silk sutures on fine eyeless needles, plays

a big part in the virtual absence of scars and stitch marks. In only one instance did a suture cause trouble; in this case the stitch at B B' was inadvertently cut at the knot and came untied next day with a subsequent widening of the scar.

The percentage of cases that will require any secondary operation is steadily diminishing as better results are being obtained with the free red mucosal surface. Although the kinking of the re-formed nostril and to a lesser degree the slumping of the ala are being gradually overcome they still present the most formidable obstacles to the ideal that we must always aim at, namely, a reconstruction that will result in a symmetrical and pleasing baby face without scarring.

In assessing results the value of "before" and "after" photos cannot be overstressed. These photos must be taken in such a way that they show up both the pre-operative deformities and the post-operative defects to a maximum.

In unilateral cases this means that there should be, both before and after operation, two full face views, one with the baby looking straight into the camera and the other with the baby's head tilted back to show the nostril openings. It is an advantage to employ the same photographer throughout and preferably one skilled in clinical photography. The prints must be on glossy paper without any touching up whatever.

Nothing can be more misleading than a photo which is taken in such a way as to minimise a post-operative defect.

#### SUMMARY.

Forty-five cases of primary unilateral hare lip repair have been selected from a series of facial cleft operations and subjected to critical review. The deformities to be overcome have been discussed and the technique of the operation has been described. Attention has been directed to the significance of the various stages in the operation and to the methods employed in an attempt to overcome the more common post-operative defects. The importance of a photographic record of all cases has been stressed and a series of photographs showing progressive grades of deformity has been included to emphasise this.





FIG. VII A



FIG. VII B.



FIG. VII C.



FIG. VI A.



FIG. VI B.



FIG. X A.

FIGS. VI A, B. An incomplete cleft with very little nostril defect, but with a groove above the cleft. In these cases signs of surgical repair should be minimal.

FIGS. VII A, B, C. An incomplete cleft with some nasal deformity: the primary lip repair is satisfactory, but the alar base has not been returned quite enough.

FIGS. VIII A, B, C, D. Repair of an incomplete cleft associated with marked nasal deformity. A symmetrical and mobile lip has been obtained and the alar base is well returned without kinking, although the nostril is not quite symmetrical.



FIG. VIII A.



FIG. VIII B.





FIG. IX A.



FIG. IX B.



FIG. IX C.



FIG. X B.



FIG. XI A.



FIG. XII B.

FIGS. IX A, B, C. This complete cleft shows marked tilting of the pre-maxilla as well as the usual nasal deformity. Repair has resulted in satisfactory moulding of the pre-maxilla with a symmetrical nose and lip at eighteen months old.

FIGS. X A, B. A wide, complete cleft with an alar attachment much lower than the opposite side: a symmetrical nose and lip have been obtained.

FIGS. XI A, B. This wide gap has produced gross nasal deformity with all the usual stigmata, including an ala much longer than on the sound side. The nostril repair is considered satisfactory, but the lip needs further adjustment.



FIG. VIII C.



FIG. VIII D.

## SQUAMOUS EPITHELIUM IN BURSAE.

### THE IMPORT OF THE NON-SPECIFICITY OF THE GERM-LAYERS.

By E. S. J. KING.

Melbourne.

*First Witch: When shall we three meet again,  
In thunder, lightning, or in rain?*

*(Macbeth: Act. I, Sc. I, 1.1.)*

THE infinite variety of conditions encountered by clinicians and pathologists is responsible in some measure for the enthusiasm with which most of us, all our lives, pursue the solution of the problems presented. It is natural that our attention should be arrested by the more bizarre phenomena, but though we note these with interest, we seldom attempt seriously to interpret their meaning. This is because psychological barriers have been raised which inhibit acceptance of our observations, or at least allow us to examine them only from such a narrow or oblique viewpoint that we fail to realize their significance.

This was so emphasized recently during the examination of an uncommon specimen of a prepatellar bursa that, in addition to the description of the specimen, a review of some of the pertinent fundamental propositions seemed desirable. It might be thought that such review is more appropriate to a biological than to a surgical journal. Nevertheless there are two valid reasons for consideration here. First, the undergraduate student of medicine spends considerable time in absorbing certain general biological principles and is confirmed by his clinical teachers in his acceptance of these. If they should be mis-stated or garbled, the waste of so much valuable time is regrettable. Secondly, a good deal of evidence relating to these principles is to be obtained from the material observed by the surgeon and pathologist, and therefore he should be regarded as having an intimate, even if not proprietary, interest in the problems.

Abnormal conditions are commonly regarded as something apart from those usually seen, but, after all, even here the tissues are still living and growing structures, and that they behave in what is regarded as a peculiar manner is merely an indication of their

capacity to continue to exist in adverse circumstances rather than that they have become something different. Often it has been stated or implied that abnormal conditions cannot give any information as to the nature of tissues because they have become so different that such knowledge can only be obtained from the normal; at the same time the nature of changes occurring in abnormal circumstances must be deduced from normal tissues. This kind of reasoning has been used all too frequently in biological discussions. Of course, if the traffic be closed in one direction, it must be obstructed also in the other. Nowadays most biologists accept information obtained from abnormal states, especially those experimentally produced, but many are also using pathological material.

Relatively few naturally occurring diseases are discovered amongst animals so that the wealth of material obtained from human sources becomes of extreme importance. Thus, whether it be appreciated or not, the pathologist occupies an important place in the biological field, and his numerous observations demand some consideration.

The case recorded here is one of a host of uncommon conditions that are to be observed, though this particular phenomenon is a rare one.

#### CASE HISTORY.

Mrs. D.R., aged 50, had had a "lump" on the front of the left knee for twenty-five years. This had gradually enlarged until, at the time she sought attention, it measured about 2 inches in diameter. When examined, the mass was fluctuant in nature, subcutaneous in position, lying over the lower part of the patella and the patellar ligament, and was somewhat movable on the deeper tissues. It was diagnosed as an enlarged prepatellar bursa.

It was excised.

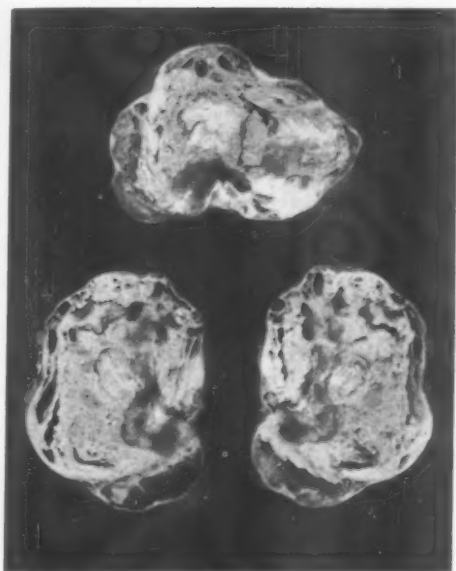


FIG. I. Photograph of the specimen after removal and fixation. The mass was divided into three pieces by two parallel cuts and the cut surfaces are shown. The contents are solid and semi-solid in most parts, but one locus particularly has lost its fluid contents.

The specimen consisted of a soft, flattened ovoid mass of tissue measuring  $2\frac{1}{2}$  inches by 2 inches by  $1\frac{1}{2}$  inches. It was firm and elastic in consistency and had a fibrous capsule. On section, the capsule was well defined, but thin, and there were fibrous strands running through it. Between these there was a soft homogeneous material which, in some parts, appeared mucoid and in one area liquid, but in others more solid. Some of this material seemed to be laminated. In one part the fluid contents escaped, leaving a locus with a smooth wall (Fig. I).

Histologically, the capsule was composed of fibrous tissue on the inner aspect of which there was a stratified layer of polyhedral cells. The number of layers was different in different parts and the size of the cells varied (Fig. II). The basal layer in some parts merged with the subjacent connective tissue cells, though in other areas there was a clear distinction (Fig. III). A well-defined basement membrane was found only in an occasional area. The superficial cells in some parts merged into an amorphous material, constituting a middle zone (Fig. IV), but in others there was a clear

demarcation. In some places the cells contained granules whose morphological and staining characters indicated that they were eleidin. Prickle cells were uncommon, but were prominent in some parts (Fig. V).



FIG. II. Photomicrograph of portion of the wall of the bursa showing a lining of stratified cells which give the general appearance of an epithelium. Demarcation between this and the underlying tissue is not sharp and the superficial cells are not flattened. (x 180)

In no part examined were there cholesterol crystals or giant cells such as are usually found in some part of an epidermoid cyst. The material of the middle portion did not give staining reactions characteristic of keratin, so that, at least, most of the contents was not composed of this.



FIG. III. Photomicrograph showing the epithelium in higher magnification. It is here sharply defined on its deep aspect. An area of special differentiation (not demonstrably keratinous) is present. (x 260)

#### DISCUSSION.

In this case there is a mass of tissue which had been present for a quarter of a century, lying in the position of the prepatellar bursa and morphologically showing the general features of an enlarged bursa. When it was examined after removal, it appeared to be a typical example of a bursa that had been

the site of chronic inflammation for many years. When examined histologically it was a matter for astonishment that a stratified epithelium was present, a reaction justified in so far as a tissue resembling a stratified epithelium is rare in a bursa.



FIG. IV. Photomicrograph of portion of the wall of the bursa showing good definition of epithelium from the subjacent tissue, but without a clear basement membrane. The superficial cells are not clearly demarcated from each other and the tissue is not defined from the amorphous contents of the space. (x 210)

The rarity of this phenomenon has led some observers to go farther and say that such a condition must be a cyst (or tumour) of epithelial origin and cannot be a bursa, and this kind of statement is to be found in some writings on the subject. This makes a close scrutiny of the problem desirable.

On the one hand a clinical history and macroscopic appearance points one way, while on the other hand a somewhat cursory observation of the cells lining the walls appears to point another. Most of the lining cells, though stratified in arrangement and having a superficial resemblance to those of squamous epithelium, differ strikingly from them in several particulars: (i) they are not clearly separated from each other (forming in many places a syncytium); (ii) in most parts there is not a good basement membrane; indeed, they merge into the subjacent tissue; (iii) they do not produce keratin, which is such a characteristic feature of epidermal cells\*; and (iv) there

\*It is not implied that keratin is never formed; merely that in this case and in similar ones keratinous material has not been observed.

are no cholesterol crystals or sebaceous material, nor are there foreign-body giant cells. These last, on analogy with sebaceous or epidermoid cysts seen elsewhere, would be expected to be present in a cyst of epidermal nature particularly in a cyst which had been present for so long.

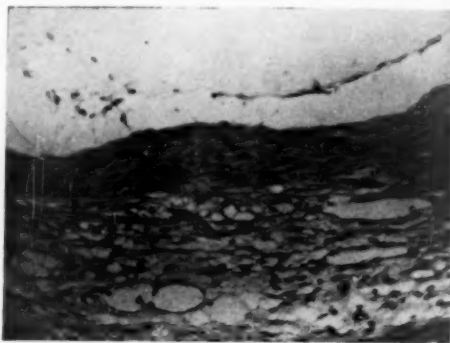


FIG. V. Photomicrograph of portion of the wall showing a stratified squamous epithelium with well-defined inter-cellular spaces with "prickles". The epithelium is not defined clearly from the subjacent tissue. (x 160)

It is clear, therefore, that the lining cells found in this kind of case do not correspond very closely with those occurring in epithelium-lined cysts of ectodermal origin. Thus if we postulate that this cyst is epidermal, apart from any question of its topographical and macroscopical features, it is histologically atypical. Regarding the prickle cells it is germane that inter-cellular bridges have been found between the cells lining surfaces in the deeper tissues which are of mesodermal origin (Heidenhain, 1893).

An example of an olecranon bursa, in a male aged 54, showing a lining of stratified epithelium of squamous type, has been described by Heinrich Müller (1929). This case has been noted by several writers, and it is usually stated that it is not possible to prove that the epithelium did not arise from implanted epidermis. Experience with implantation cysts would not encourage this viewpoint, since the lining of such cysts is quite different from that both of Müller's case and the one described here. Despite this, the onus to disprove an epidermal origin, before the lining can even be considered as arising in the bursa, is placed on those who would consider a connective tissue origin.

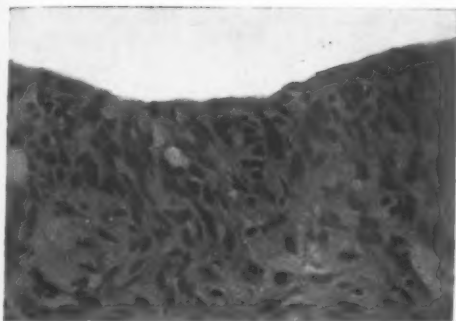


FIG. VI. Photomicrograph of portion of the wall of a semimembranosus bursa (from a male aged 24; the bursa had been enlarged for six months). The synovial membrane is typical in that it is composed of connective tissue—the cells lying in the tissue near to but not necessarily on the surface. ( $\times 220$ )

It thus becomes necessary to examine the concept that the histological nature of the lining tissue itself proves it to be epidermal in origin. This is derived directly from a commonly accepted tenet of the germ-layer hypothesis that certain tissues arise only from one or other layer. This is a determining factor in so many of our problems and the implications are so far-reaching that the whole question deserves study.

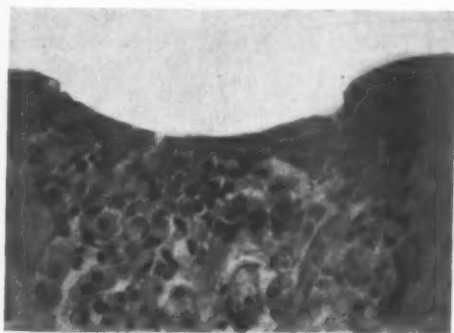


FIG. VII. Photomicrograph of part of the wall of a semimembranosus bursa (from a female aged 32; the bursa had been swollen for three months) showing a typical synovial membrane composed of connective tissue. An occasional cell here lies on the surface. ( $\times 200$ )

#### THE THREE GERM-LAYER HYPOTHESIS.

The germ-layer hypothesis has dominated a large section of biology and a larger part (relatively) of pathology for nearly a hundred years. It has moulded thought and has provided a considerable burden (a burden because of its misapplication) to the

student preparing for the study of clinical medicine and surgery. In addition, it has determined the direction of much pathological investigation. In cases such as that cited here it would (unless opposed) determine the morphology, histology and aetiology of the condition. Also it would do this in the face of inherent improbabilities. The history of the hypothesis throws considerable light on its importance and significance.

#### Historical.

Until the nineteenth century individuals were regarded as being preformed in the substances, tissues or cells from which they arose. Thus Nicolaus Hartsoeker (1694) gives an illustration of a spermatozoon containing and consisting of a fully formed minute body-homunculus. Antoni van Leeuwenhoek (1699) reproduced figures of a similar kind from Dalenpatius, but was sceptical of them. Marcello Malpighi (1673), Jan Swammerdam (1758), Lazzaro Spallanzani (1765), Albrecht von Haller (1766) and Charles Bonnet (1780) all maintained that individuals were preformed in ova. The preformation hypothesis is important even to-day because some remnants of it are still to be found.

At the end of the eighteenth century the observations of Caspar Friedrich Wolff (1759) showed clearly that the embryo had a recognizable structure in which subsequent organs were not present as such and thus opened the way for the acceptance of the doctrine of epigenesis—that an animal developed by the addition of parts and tissues that were not present originally.

In 1817 Heinrich Christian Pander gave the name blastoderm to the area of the developing chick embryo. Describing the early stages of development, he said: "... the blastoderm consists of two entirely separate layers, an inner one, thicker, granular and opaque, and an outer one, thinner, smooth and transparent. The latter ... we may call the serous layer, and the former the mucous layer. ... There arises between the two layers of the blastoderm a third middle one in which the blood vessels are formed ... which therefore we call the vessel layer. ..."



These observations were applied almost immediately to other animals by two famous investigators, Karl Ernst von Baer and Martin Heinrich Rathke. von Baer (1828) applied the discovery to vertebrates generally; Rathke (1829) applied it to invertebrates. Because it was more comprehensive, von Baer's work attracted more attention and indeed formed a basis for subsequent embryology. Two points deserve comment: first, von Baer expanded Pander's three layers into four (an example of the many unhelpful modifications that have appeared), and secondly, the comprehensive character of his generalization gave it an apparent finality that discouraged investigation and was thus destined to cause a lag in progress.



FIG. VIII. Photomicrograph of portion of the wall of a bursa (from a male aged 37; swelling of ten weeks duration) showing a connective tissue lining. There is a concentration of cells near the surface, but only an occasional cell is actually on the surface. (x 220)

For a quarter of a century this was accepted without modification. Robert Remak (1850) then amplified the general idea by indicating clearly that the cells of the germ-layers were derived from the ovum, and secondly (what has been the keystone and at the same time the principal shortcoming of the hypothesis) that each germ-layer has a specific destiny. At the same time Thomas Henry Huxley (1849), from material gathered during his term as surgeon to H.M.S. "Rattlesnake" in Australian waters, described the layers in the adult Coelenterates.

In 1853 George James Allmann gave the names ectoderm and endoderm to layers of the Coelenterates. Again for a period no further significant change was made, and indeed the various ideas did not attract much attention until a Russian, Alexander Kowalewski (1867), following the study of a series of animals, proclaimed that the germ-

layers were universally present and that in all animals they were comparable and arose in a similar manner. Probably because of the period at which it was published and since it supported the growing ideas of evolution, it attracted considerable and immediate attention. In 1871 Huxley introduced the term mesoderm. About this time Fritz Müller and Kleinenberg, amongst others, definitely related Ontogeny with Phylogeny — "Ontogeny recapitulated Phylogeny."

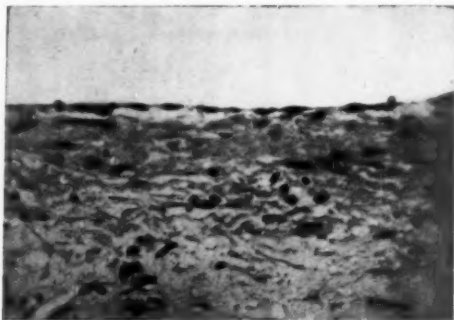


FIG. IX. Photomicrograph of part of the wall of a semimembranosus bursa which had been enlarged for three months (from a male aged 15). The lining is composed of a layer of cells of endothelial type. (x 240)

Up to this time the problem of the layers was a general biological one. It was not until 1872 that the terms ectoderm, *etcetera*, were applied to the embryo by Ernst Heinrich Haeckel (1872) and Edwin Ray Lankester (1873). In the next year Lankester and Balfour introduced the terms epiblast and hypoblast with their somewhat different but extremely significant implications. This was the focal point from which arose most subsequent controversy.

Haeckel, combining a highly developed aesthetic sense with a capacity for organization and a passion for method, produced schemata, many of which are still found, in more or less modified form, in textbooks to-day. The delightfully symmetrical drawings became an end in themselves and set the course for embryology for many years. The implication of these schemata was that the layers were immutable and so the various layers with the tissues related to them became fixed in a rigid mould. The sharp distinction between layers observed at some stages was carried throughout the whole life of the



individual. The possibility of differences between different genera or orders or of changes in altered circumstances were not envisaged—indeed, their possibility was denied.

Thus it was not until the eighteen-seventies that the germ-layer hypothesis was elaborated in the form in which it was subsequently used. What is not generally appreciated is that in less than a decade protests began to appear. At this time there were two groups of biologists. The first, consisting mainly of teachers and writers of textbooks, adhered closely to Haeckel's diagrams and the simple orderly statements associated with these, doubtless because of the relative ease of teaching these and the apparent profundity of the generalizations. The other group comprised the investigators who produced an ever-increasing volume of protests.

The revolt was led by Oscar and Richard Hertwig (1878) and Rudolf Albert von Kölliker (1879). The Hertwigs developed their own special hypothesis (the coelome hypothesis), which was soon criticised in its turn, but they did accumulate much information both of their own observation and from other writers which indicated that the rigid ideas associated with Haeckel's conception should be discarded. Kölliker considered the matter from the point of view of the histologist. Histology, of course, is objective and the least unreliable type of evidence that can be obtained. He showed that several kinds of tissues could be found to arise from layers to which they were supposed to be foreign. One point, supported at the time by such observers as Leydig and Ranvier and borne out by recent observations, was the origin of smooth muscle (of sweat glands) from ectoderm. Details of his claims, some of which have since been shown to be wrong, do not now matter since they were followed by those of many other investigators.

The attitude of some writers of the period is shown by the title of Braem's (1895) paper, "What is a germ-layer?" and Karl Heider's, "Is the germ-layer theory demolished?" In 1896 Edmund B. Wilson stated that "... we cannot assume that the germ-layers have any *fixed* morphological value..." In 1906 Jenkinson wrote: "The germinal layers are not... of universally

identical origin which necessarily and invariably give rise to certain fixed parts of the adult organization."



FIG. X. Photomicrograph of part of the wall of a bursa which had been enlarged for twelve months (from a male aged 56). There is an aggregation of cells at the surface. (x 240)

At the beginning of this century, then, the germ-layer hypothesis had been in existence in its fully-fledged form for only thirty years, and for twenty of these had been strongly contested by prominent observers. In fact, from a perusal of the literature, it is clear that from 1880 onwards the protagonists of the hypothesis in its complete form were only those who were willing to sacrifice and ignore observations in favour of its illusory simplicity. Well-defined layers are to be found especially in those embryos which have large egg yolks, but that they constitute an embryological criterion of homology or indicate an immutable direction of development was contested.

#### *Some modern observations.*

One of the principal tenets of the germ-layer hypothesis is that structures of the same kind, that is, homologous tissues, in different kinds of animals are considered to arise consistently from corresponding layers. Thus certain epithelial structures arise from ectoderm, whereas connective tissues and other supporting tissues arise from mesoderm.

As long ago as 1888 Kastschenko claimed that in some fish certain tissues usually regarded as mesodermal (visceral cartilage) arose from the neural crest. This was supported by Goronowitsch (1892) in birds and by Julia Platt (1897) in amphibia.

Subsequently many reports have been made, but since the question has been studied by experimental extirpation of neural crest cells or grafting and by using modern staining methods, some of the older objections need not be discussed here. A bibliography is given by Ross Harrison (1938) and the matter has been reviewed recently by de Beer (1947).

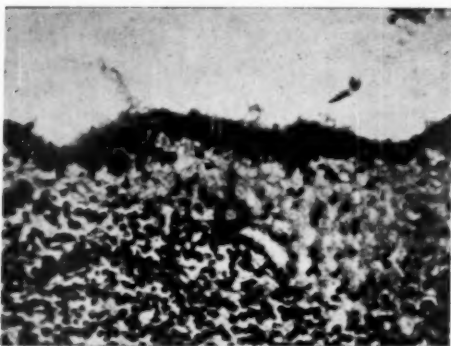


FIG. XI. Photomicrograph of portion of the wall of a bursa which had been intermittently swollen for "many years" (from a male aged 54). The lining is well defined and of a columnar cell type. (x 200)

From this it is clear that adult cartilage *qua* cartilage may be derived from both ectoderm (that it is named ectomesoderm does not effect the issue) and also mesoderm. This is of greatest importance to the pathologist. To the biologist it indicates that the forms adopted by some cells are determined by stimuli acting on them irrespective of the layer that they happen to occupy. The pathologist, when he deals with histological structure, is not compelled by any biological law to assume necessarily a specific origin from this structure.

Examples were found in which structures arose from either ectoderm or endoderm. Thus taste buds are formed in *Ameiurus* (an elasmobranch) from ectoderm in the epidermis and from the endoderm in the pharynx (Landacre). The thymus is especially interesting, since in the opossum the anterior thymus arises from both ectoderm and endoderm (Fraser and Hill), in the rabbit and man it is solely endodermal, and in the pig and the mole it is entirely ectodermal (de Beer). Here again the available tissue provides the material for a structure independently of the layer it occupies. The

origin of odontoblasts from ectoderm in *Amblystoma* has been demonstrated by de Beer (1947). The formation of the alimentary canal of an insect (weevil) from ectoderm, as shown by Teigs (Murray and Teigs), is a further example showing the widespread extent of discrepancies.

These observations, so widely scattered through the animal kingdom, are mentioned here since it was the comprehensive character of the observations of von Baer and the encyclopedic and esoteric features of the hypothesis of Haeckel ("... the animal phyla have a common descent from a single unknown stock form, gastraea..." composed essentially of a gastral cavity) that launched the germ-layer hypothesis. Any criticism of it can only be assessed intelligently if it be viewed in a correspondingly wide manner.

#### *Experimental work.*

The greatest advances, because of the clear-cut nature of the evidence obtained, have been made by the experimental approach to the problems. These have been carried out in many ways and reference should be made to special works for details because the ingenuity and patience that have been expended on them deserve far greater recognition than they usually receive from workers in other fields—especially the medical sciences.

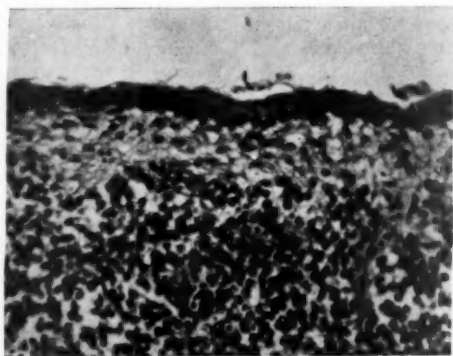


FIG. XII. Photomicrograph of part of the wall of a bursa which had been swollen for twenty years (from a male aged 60). There is a well-defined epithelial lining. (x 200)

The experiments consist of removal of part of an embryo, with observation of both the embryo and the piece removed (Holt-

freter, 1938), transplantation of cells and portions of tissue from one part to another, transplantation of tissues from other species (Spemann, 1924), separation and recombination of cells (Hörstadius, 1935), placing embryos in different solutions, and especially since the discovery of the chemical nature of organizers, carcinogens and some hormones, the introduction of these into various parts of the embryo (Waddington and Needham, 1936; Needham, 1942).

The first of these were the chemical experiments of Curt Herbst (1892), who found that immersion of embryos in solutions of lithium salts resulted in the development, in Coelenterata, of excess endoderm at the expense of ectoderm. This work was elaborated by von Ubisch (1929), who showed that treatment with lithium salts would enable segregated ectoderm to give rise to both ectoderm and endoderm, and Lehmann (1937), who showed similar extension of demonstrable potentialities of the notochord. Lindahl (1936) showed that sodium sulphocyanide or the absence of sulphate ions results in endoderm becoming ectoderm.

The mechanical interference type of experiment (removal, transplantation and implantation of tissue) was initiated in its modern form by Hans Spemann. A tremendous series of experiments has been carried out by Spemann, the Mangolds and Holtfreter amongst many others. It has been shown that medullary plate will grow from presumptive mesoderm (Bruns, 1931) and that when the endoderm has been removed, the gut wall will develop from mesoderm (Hunt, 1937). A mere suggestion of the general direction of this work is all that can be dealt with here.

In a general view of the problems Spemann (1926), from a consideration of xenoplastic inductions (i.e., where cells of an embryo of one species are transplanted into another species, genus or family), states that features develop as a "function of position." Physiological activity is more significant than details of structure. Indeed, throughout the animal kingdom it is processes rather than structures that are homologous. It follows that if the circumstances of development—the stimuli acting on the cells—be the same in different animals the mode of formation of tissues and organs is quite likely to be

the same, but if the circumstances vary or are varied, then the mode of formation will be different, and, as has been seen, organs may not always come from the same layers. "... the germ-layers ... have an actual potentiality and a total potentiality; the former is what they normally become; the latter what they are capable of in addition under diverse natural or experimental influences" (Brachet, 1935).



FIG. XIII. Photomicrograph of part of the wall of a bursa which had been swollen at intervals for "years" (from a male aged 56). The sharp distinction of the epithelial lining from the subjacent tissue is shown where it has become detached. (x 200)

#### *Pathological conditions.*

In 1894 Johan Hjort (1895) made the significant discovery in Ascidians that individuals formed by budding did not arise in the same way as they did when developed from ova. The adult structures in the two cases arose from cells of different germ-layers. Clearly this struck at the very roots of the hypothesis.

In 1897 Heider maintained that this did not affect the hypothesis as far as embryology was concerned because regeneration and budding are something quite distinct and apart from normal development. This viewpoint has been accepted by several investigators and even recently Jane Oppenheimer (1940) stated: "The perfectly valid objection can be raised that ... the cells ... have been observed acting under highly abnormal conditions. ..." The validity of such objections, however, is completely vitiated by the absence of any attempt to indicate what is meant by normal and

abnormal. If by abnormal we mean something that is away from the mean, then it is only a variation of the normal and the differences an indication of inherent potentialities (Brachet). If we mean something special and different from living tissue, we reach an absurdity. Even in 1904 Ballantyne stated that "the abnormal and the normal will prove mutually elucidative."



FIG. XIV. Photomicrograph of part of the wall of a semimembranous bursa which had been intermittently swollen for forty-five years (from a male aged 62). There is a well-defined lining of closely packed cells about 3 layers thick. (x 200)

If portion of amphibian larvae (obtained from one germ-layer) be cultured in saline solution, they produce only the tissues usually associated with them, and perhaps only some of them, for example, ectoderm may produce only epidermis (Holtfreter, 1933). If another layer be present, then nervous tissue develops as well. If, however, the ectodermal tissue be placed in the abdominal cavity (Holtfreter, 1929) or orbital cavity (Bautzmann, 1929; Kusche, 1929) of older larvae, notochord and muscle are produced as well. The important thing is that different phenomena occur in different circumstances, and these may be very different from those usually observed. This point seems to have been overlooked by Berrill (1935), whose observations show the multipotential character of some layers, but whose deduction was that some "differentiated" cells have rigidly limited capacities.

Many pathologists have attempted to make their observations fit the germ-layer hypothesis; Marchand and Adami were prominent amongst these. Such attempts have had to be modified and finally abandoned in the

face of the irresistible tide of observations (King, 1948). The laws of germ-layers "are but man made after all." (Nicholson, 1918.)

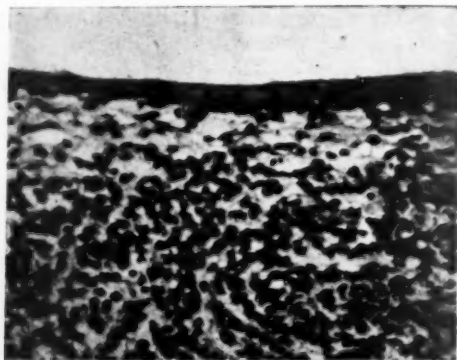


FIG. XV. Photomicrograph of part of the wall of the same bursa as shown in Fig. XIV. There is a well-defined lining, distinct morphologically and in staining characters from the subjacent tissue. (x 210)

In adult tissue we find many structures throughout the body clearly arising from any or all the germ-layers. This applies to easily recognizable epithelia such as columnar epithelium (for example, with goblet cells) and squamous epithelium. Here, viewing the matter from a slightly different angle, the recent paper by Waddell (1949) on the development of bronchial epithelium from mesoderm is noteworthy. Cartilage and muscle tissue also are found in places and in circumstances indicating an origin from other than mesoderm. For the present purpose the formation of an epithelium of the squamous type only requires discussion.

#### *Observations on Bursae.*

From the above review it is apparent that there is no inherent improbability, from the general biological viewpoint, in an epithelium of a stratified and squamous type arising in a connective tissue. Secondly, observations on the details of development of vertebrate embryos and of human adult tissues make it apparent that a stratified squamous epithelium may be found in structures arising in all layers. An origin from mesoderm — which is important here — is shown, in normal circumstances, in the squamous epithelium of the cervix uteri. The formation here even of "skin" (squamous epithe-

lium with appendages) is well known (Nicholson, 1936). Stratified epithelium is found in the peritoneum and in cysts of the spleen and the observation of prickle cells in such epithelium by Martin Heidenhain has been mentioned already. What is necessary here is to produce some evidence that this does actually occur in bursae.

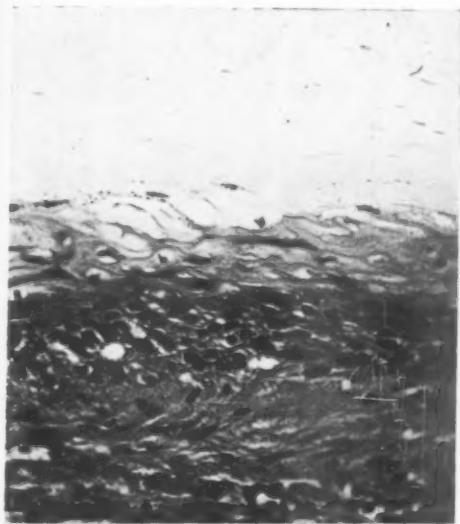


FIG. XVI. Photomicrograph of portion of the wall of a bursa near the shoulder joint which had been intermittently swollen for "several years" (from a female aged 42). It is lined by a layer of stratified cells which are packed closely together with intercellular bridges. The superficial cells merge into the homogeneous contents. (x 220)

That there is considerable variation in the histological appearances of synovial membrane was noted early and in 1894 J. A. Hammar described a cell-poor and a cell-rich type of membrane. A variation in the number and arrangement of cells, particularly in relationship to the surface margin, has been illustrated by the writer (King, 1935). The development of a specialized surface lining (described as endothelial) found especially in tumours of this tissue has been described by Fisher (1942). It is thus apparent that in different conditions, synovial membrane may vary considerably in the morphology of its lining.

In the specimen described here we are dealing with a late end result, and we cannot therefore expect to find evidence of actual transformation of tissue. To obtain

some indication of the direction of cell changes it is necessary to assemble a series of examples of similar conditions at different stages of progress. This is what the embryologist does when he examines embryos of different ages. A group of bursae removed because of persistent enlargement was therefore examined.

A series of bursae (45), occurring in both sexes and at age periods ranging from 15 to 66 years and of different durations, was graded according to the kind of changes taking place on the free internal surface. The discrepancies between the different individuals is recognized, but, since all that is to be deduced is that certain changes can occur, the degree of change may be taken as a satisfactory criterion for grading. Four cases are taken as representative of distinct stages.



FIG. XVII. Photomicrograph of part of the wall of the bursa described in case history and illustrated in Figs. I-V. (x 220)

1. A male, aged 24, had had a swelling behind the right knee for six months. It was diagnosed as a semimembranosus bursa and was removed. At operation it was found not to communicate with the knee joint. Histologically the thickened wall was lined by a typical normal synovial tissue (Fig. VI). This appearance was characteristic of the majority of the specimens examined (Figs. VII and VIII) and because it is found in normal membranes it is clearly the starting point from which other types must proceed.



2. A male, aged 15, had had a swelling behind the left knee for three months. An enlarged semi-membranosus bursa which did not communicate with the joint was excised. Histologically the surface of the synovial membrane was covered by a distinct single layer of cells. These were characteristically "endothelial" in form and show clearly that synovial tissue, though usually a modified connective tissue (Key, 1928), may develop the characteristics of an endothelium (Fig. IX).

3. A male, aged 56, had had a swelling behind the left knee, associated with intermittent swelling of the joint for twelve months. An enlarged semi-membranosus bursa which communicated with the joint by a minute opening was removed. Histologically the lining was of the typical synovial type, but there were more cells than usual close to and on the actual surface of the membrane (Fig. XI).

4. A male, aged 62, had had intermittent swelling of the left knee for forty-five years. It had been swollen persistently for six months. There was a swelling in the region of the semimembranosus bursa. Because of disability, related by the patient to this local swelling, it was excised. It communicated with the joint by a small opening.

The bursa had a thick wall and the internal lining was villous. Histologically the synovial tissue was cellular and the superficial portion was so distinct as to constitute a separate layer. This consisted of a zone of from two- to three-cell thickness, sharply demarcated from the subjacent tissue and having a well-defined inner surface (Figs. XIV and XV). The cells were irregularly arranged; the protoplasm was deeply staining. Similar examples are illustrated in Figs. XI, XII and XIII.

These various examples constitute a series which provide a gradation of changes from the usual (that is, normal) connective tissue character of synovial tissue, through an endothelial lining to a distinct inner layer of an epithelial type (Fig. XVIII). This is designated epithelium because of the minimal amount of intercellular material, its distinction from the underlying tissue and because it lines a surface. This tissue constitutes an approach to the definitely stratified type described in the case of the prepatellar bursa recorded above. Obviously many intermediate stages are missing, probably because this type of change is rare, but if attention be directed to this matter, examples of these stages should gradually be provided.

#### SUMMARY.

An example of a prepatellar cyst lined by stratified epithelium is described. An opinion that this is an epidermal cyst or tumour depends on an acceptance of the

three germ-layer hypothesis, which would imply that stratified epithelium, especially if squamous, is necessarily of ectodermal origin.

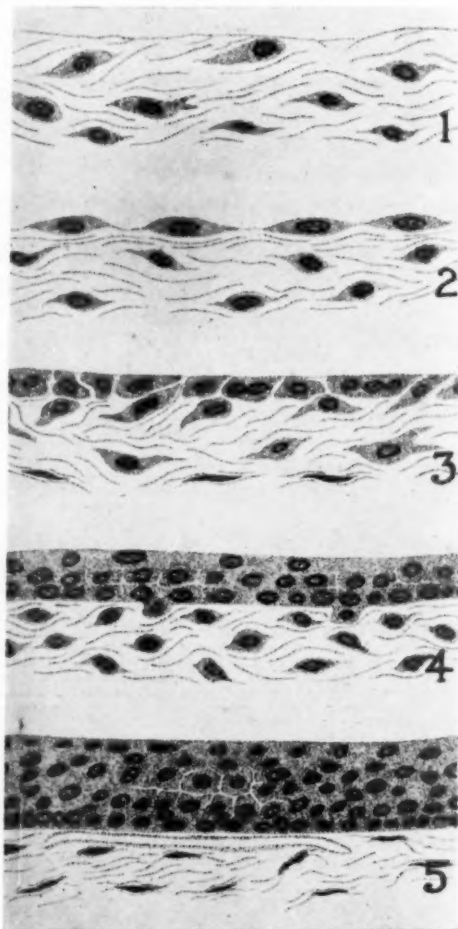


FIG. XVIII. Drawing to show diagrammatically the changes which are to be seen in synovial membrane (of bursae) in various conditions. These are illustrated in the various photomicrographs and are interpreted as being stages in the development of an epithelium.

1. Typical synovial tissue consisting of a free connective tissue surface. Cf. Figs. VI-VIII.
2. Synovial tissue modified so that it is now covered by "endothelial" cells. Cf. Fig. IX.
3. Membrane with aggregation of cells at the surface. Cf. Fig. X.
4. Membrane with a definite lining of an "epithelial" type. Cf. Figs. XI-XV.
5. Membrane with a lining of the type described in the case recorded here. Cf. Figs. II-V and XVII.



The problem of the specificity of the germ-layers is examined briefly from the general biological viewpoint. Although it is not possible to do more than indicate in a very sketchy way the main points (biological details of species, *etcetera*, are not given), an indication of the breadth of the question and the great volume of investigation is provided. The experimental work is discussed and some of the pathological observations are mentioned. From whichever of these viewpoints the question is considered, it is apparent that the germ-layer hypothesis is largely phantasy.

That there are three layers to be seen at certain stages of development of some animals (particularly those with large egg yolks) has been abundantly demonstrated, but it has been shewn that any *a priori* opinion that a condition such as that described here must be epidermal (that is, ectodermal in origin) is unjustified. In normal conditions the three layers are separate and evolve in a usual, apparently predetermined fashion, but in "thunder, lightning or in rain" (that is, in pathological states) they show a disregard for boundaries that is the more complete the more they are studied in such circumstances.

The variations in form of the synovial membrane of bursae are shown in several examples. The specimen described here is one in which a hidden potentiality is exposed—a growth capacity of which synovial membrane is capable in abnormal conditions—the development of a stratified and squamous epithelium.

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# CARCINOMA OF THE LOWER OESOPHAGUS AND UPPER STOMACH.

By F. W. NIESCHE.

Sydney.

SINCE little has appeared in the Australian literature concerning surgery of the lower oesophagus and upper stomach it is of interest to record a series of cases and, in particular, to stress the pitfalls and mistakes which have occurred.

Only carcinoma involving the lower oesophagus or upper stomach, or both, is considered. When the growth has involved the stomach too extensively for partial resection, a total gastrectomy has been performed. To clarify the terminology, a total gastrectomy means that the oesophagus and duodenum have both been transected and a loop of jejunum anastomosed to the oesophagus; if any remnant of the distal end of the stomach has been left, it has been anastomosed to the oesophagus, and this has been termed a cardio-oesophagectomy.

In this small series there have been 13 cases of resection. A short account of these is given later in this paper. Of the 13 cases, 8 have been treated by total gastrectomy and 5 by cardio-oesophagectomy; 8 patients survived. Of them, the first in which total gastrectomy was done died at the end of six months from intestinal obstruction, but the remaining 7 cases are living.

The ages ranged from 55 to 78 years. It is significant that 2 patients 55 years of age died, while the oldest patient survived after an uneventful convalescence. Within limits, age does not appear to have a great bearing on the post-operative course; other factors are more important. In the 8 patients where total gastrectomy was performed this was done in two instances from below the diaphragm, using a complete transverse incision.

Moynihan (1915) gave a very good description of a successful subdiaphragmatic gastrectomy in 1907. His patient lived for three years.

A summary of results is shown in the accompanying table.

	No. of cases	Survivals	Deaths
Total gastrectomy Abdomino-thoracic approach	6	3	3
Total gastrectomy Subdiaphragmatic . . . . .	2	1	1
Cardio-oesophagectomy . . . . .	5	4	1
Total . . . . .	13	8	5

Seven patients are living, 4 for twelve months and over. (Cardio-oesophagectomy was also done for one patient with a gastric ulcer adjacent to the oesophagus because this was thought to be malignant. This has been included in the series, but all other cases had advanced malignant disease.)

The causes of death in the 5 fatal cases were:—

- (1) Congestive cardiac failure.
- (2) Extensive bilateral lobar pneumonia. This occurred before nebulized intra-bronchial penicillin was used.
- (3) Massive pulmonary embolus.
- (4) Secondary pulmonary collapse due to leakage in the rubber underwater drainage tube.
- (5) Bronchopneumonia, caused by inhaled intestinal contents, due partly to a faulty Magill's tube and partly to incorrect posturing of patient.

Three of these deaths could have been prevented, and with increasing experience the causes will be eliminated. The patient who died with a massive pulmonary embolus had survived a second laparotomy for intestinal obstruction. It was thought that the batch of heparin used might have been faulty because it had little effect on the blood coagulation times.

Much progress has been made in this type of surgery during the past ten years, and even if a cure cannot be obtained, palliative surgery appears to be justifiable if the patient can lead a comparatively normal existence for a year or more. There is no alternative for these people except perhaps a gastrostomy or jejunostomy and an earlier death. With any operation of this magnitude an early series of cases will carry a high mortality, as stated by Doyle (1947). There will be many disappointments and much trial and error before the mortality is reduced. In early figures given by the American surgeons Sweet (1945) and Garlock (1944) the mortality was fairly high, but now that larger numbers have been done, the mortality has been very much reduced. The series herewith recorded included some very advanced cases. This is not mentioned as an apology, but as a plea for early diagnosis, as this is the main factor once the technical procedures have been mastered. Operability rate has been extended to the extreme. To a certain extent the mortality rate will be influenced according to how far operability has been extended.

#### *Early diagnosis.*

Only with a proper appreciation of the early symptoms can there be any improvement in the early diagnosis of these cases. The majority of these patients are old, but surgery in the aged, under modern conditions, is regarded as satisfactory. It should be the aim of practitioners to refer patients within three months of the onset of symptoms. This is not always possible, as there may be very few symptoms in the early stages. Symptoms due to lesions of the oesophagus are more likely to be noticed on account of dysphagia due to obstruction, whereas a longer latent period is more likely with lesions in the stomach. Regurgitation of food is often an early symptom of carcinoma of the lower oesophagus. Retrosternal discomfort may be another early symptom. Loss of weight is frequently proportional to the dysphagia. Sometimes an unexplained anaemia, lethargy and loss of weight may be the only evidence of a carcinoma of the stomach in a silent area. Cases 6 and 11 could be included in this category. In this type of case the tumour may become very large. In Case 11 the tumour became huge and was quite obvious before medical aid was sought.

A complete investigation is necessary in all cases; X-ray examination, oesophagoscopy, biopsy and gastroscopy in selected cases. Some positive X-ray findings in the lower oesophagus have been found on oesophagoscopy to be due to healed or healing peptic ulcer and oesophagitis. Kinsella (1948) has pointed out the importance of a thorough X-ray investigation for carcinoma of the cardiac end of the stomach. A carcinoma originating in the cardia of the stomach is probably an adenocarcinoma, whereas one originating in the oesophagus is a squamous carcinoma. It has been stated by Garlock (1946) that although a primary carcinoma involving the cardia can infiltrate the oesophagus extensively, the reverse is not the case. In two cases in this series, however, it was found that a squamous carcinoma in the lower third of the oesophagus had involved the cardia.

My experience during laparotomy for large ulcers on the lesser curvature and posterior wall of the stomach leads me to consider that, if the appearance of malignancy is doubtful, the lesion is usually innocent. In high ulcers I have been able to excise the ulcer and do a less radical partial gastrectomy below the site with happy results.

#### *Operability.*

In all cases the supraclavicular glands should be palpated, as any involvement will indicate that the case is inoperable. A rectal examination should be routine for gastric carcinoma, as the finding of transperitoneal deposits in the pelvic floor will contraindicate laparotomy. This applies particularly to cases which are sent from outlying country areas. A routine examination of the chest should also be made. In one instance a patient was transferred from another large hospital for operation, but X-ray examination of the chest revealed numerous metastases. If no evidence of metastases can be found, all cases are worthy of an exploratory operation. Many cases which are complicated by direct extension involving other viscera, if resectable, seem to do well. Case 8, which required removal of the left lobe of the liver, is still alive a year after operation. Many show invasion in the paracardial glands and in the glands in the pancreatic

region, but metastases in the chest are sometimes unpredictable. In Case 5, where a total gastrectomy had been performed, autopsy revealed a large carcinomatous lymph gland in the superior mediastinum to the right of the superior vena cava, although routine X-ray examination did not reveal this metastasis.

Resections should be wide of the lesion, as the spread is often much further than the macroscopic appearances suggest. When the transverse colon requires resection with the growth, it is advisable to make a primary anastomosis rather than a spur colostomy. There is a remote possibility of intestinal obstruction being caused by torsion of the small intestine round the loop, as happened in Case 11.

#### *Pre-operative preparation.*

These patients need careful pre-operative preparation. A diet with a high protein and high carbohydrate content is given. The haemoglobin value, which is usually low, is brought up to within normal limits by transfusion. Haemoglobin estimations are of more value when any dehydration has been corrected. For obstructive cases Varco's diet has been given, as this contains a very high protein and carbohydrate content and can be administered through a jejunostomy tube, although it usually needs thinning. It aims to bring the serum protein up to at least 6.0 g. per cent. Vitamin requirements are attended to, particularly Vitamin C. Renal function is important and blood urea estimations and urea concentration tests are done as a routine.

If possible, daily lavage of the oesophagus and stomach should be carried out for five days before the operation. For two days before operation, 50,000 units of penicillin are given twice daily, sulphadiazine two tablets 4-hourly and intratracheal insufflation of penicillin by nebulization as described by Orton (1947). On the day of operation a Levine's tube is passed down to the obstruction or into the stomach so that aspiration may be carried out during operation.

#### *Anaesthesia.*

The success of this type of operation depends upon competent anaesthesia. Whilst intratracheal nitrous oxide, oxygen and ether, using a cuffed Magill's tube and controlled

respiration, is satisfactory, my impression is that cyclopropane, supplemented by curare and given by the same technique, leaves the patient in a more satisfactory condition and allows a more rapid recovery. Routine expansion of the lung is performed at approximately half-hourly intervals; in fact, in recent cases the lung has usually never been quite deflated. Bronchoscopy is performed at the end of the operation.

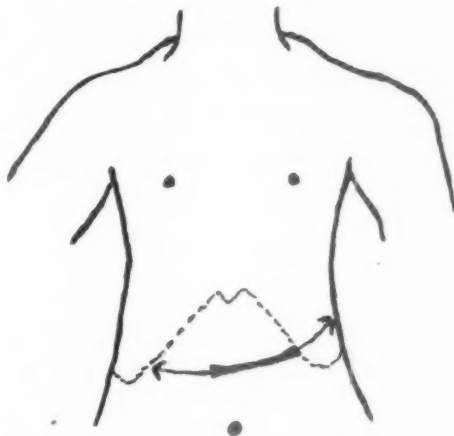


FIG. 1. Total gastrectomy. The thick line represents the oblique transverse incision for the initial laparotomy. For a subdiaphragmatic gastrectomy the incision can be extended across the abdomen. If an abdomino-thoracic approach is found necessary, the incision is extended to the left into an intercostal space.

#### *Operation.*

As so much has been published in international literature about operative technique, only certain procedures will be described. A laparotomy is done first to assess operability. In the early cases a vertical incision at the lateral margin of the left rectus muscle was used and the incision extended through the costal margin in the eighth or seventh space according to the circumstances. For the lower oesophagus the seventh or even the sixth space is used. More recently an oblique transverse incision across the upper abdomen has been used for the laparotomy. Subdiaphragmatic total gastrectomy is suitable in some cases and a transverse incision can be extended completely across the abdomen without the chest being opened. In other words, laparotomy can be done first, through a transverse incision, and when a decision is made, the incision can be extended accordingly.



Interrupted chromic catgut 0000 has been used in all cases for the oesophageal anastomosis, two layers being used in the usual way and then a third layer to telescope slightly the jejunum or the stomach, as the case may be, over the oesophagus. The sutures should be interrupted and not tied too tightly. The sutures appear to hold much more firmly in the oesophageal muscle, if carefully inserted, than is usually described. There should be no tension. With total gastrectomy an entero-anastomosis is done below the oesophageal anastomosis. For this, three layers of continuous 0000 catgut are used, the two outer layers being chromic gut and the inner plain. No uneasiness has been felt when using chromic catgut, and I have a natural dislike for non-absorbable sutures in the gastro-intestinal tract. There has been no leakage at any suture line in this series.

A loop of jejunum has been used for the oesophageal anastomosis; the Roux type of loop has not been tried. If the mesentery of the jejunum is short, one or two of the vertical vascular arcades have been cut. This has given two to two and a half inches increase in length. In the early cases of total gastrectomy a jejunostomy for early feeding was performed. Now it is considered unnecessary because a Levine's tube is passed through the anastomosis with no untoward effects, and this is used for feeding. In cases of cardio-oesophagectomy, where only a small part of the stomach may be left, the duodenum has been mobilised sufficiently to allow the pylorus to be brought almost to the level of the diaphragm. Pylorospasm, as described by others, has not been encountered because of the vagal section. A few interrupted sutures have fastened the stomach to the diaphragm to prevent any tension of the anastomosis. The diaphragm has been closed with interrupted chromic catgut sutures, as has the intercostal space. Portions of the rib cartilages have been shaved off to allow easier approximation of the ribs. An underwater drainage tube has been inserted through the ninth intercostal space in every case where a thoracotomy was performed. The lung is fully expanded at the end of the operation and the underwater drainage is connected as soon as the incision is closed. A blood transfusion is given during, and continued after, the operation.

Sulphonamide and penicillin powder has been sprayed into thoracic and abdominal areas concerned before closure of the incision. The spleen has not been sacrificed unnecessarily.

#### *Post-operative management.*

Nothing is given by the mouth for four or five days. Continuous suction is maintained through a Levine's tube for forty-eight hours, intravenous fluids being given during that period. After forty-eight hours, feeding can be commenced through the Levine's tube, gradually lessening the intravenous fluids as the quantities increase. The tube is removed about the fifth day and natural feeding commenced.

Attention is paid to the water balance during the post-operative period. The importance of serum protein estimations needs to be stressed. It is also important to avoid giving excessive amounts of intravenous fluids. Vitamin C is given as a routine.

X-ray examination of the chest with a portable machine should be made on the day following the operation to find out if the lung is completely expanded. There is always some left pleural effusion. X-ray examination should be repeated on the fourth day, and if satisfactory, the underwater drainage can be discontinued.

Suction bronchoscopy may be required on the day following operation. It is considered that if frequent bronchoscopy is required, the patient's outlook is poor. It is preferable to encourage the patient to cough up any retained secretions; in this he is helped by one of the nursing staff supporting the thorax and abdomen.

It is most important to prevent anoxia, however slight, so as to avoid any secondary cardiovascular effects. A clear airway should be maintained and oxygen given through an indwelling nasal tube, continuously at first and then intermittently, for four or five days. Post-operative atelectasis and bronchopneumonia are lessened by these procedures.

Measures to combat pulmonary thrombosis or embolism should be taken. The patient should be encouraged to move about in bed as much as possible. Blood coagulation times have been estimated as a routine and the necessary treatment with heparin and



dicumarol, according to the method of Cummine (1948) has been given when indicated.

### CASE REPORTS.

#### CASE 1. *Total Gastrectomy.*

C.F., male, aged 69, was admitted to the Royal Prince Alfred Hospital on July 10th, 1947. His symptoms were dysphagia and loss of appetite for about nine months; he had lost 14 pounds in weight during the last three months. Food "stuck in his throat" and caused a full feeling in the epigastrium. Dyspepsia had been present since 1942 and a melaena occurred during that year.

He had been in hospital four months previously with symptoms of dysphagia. Investigation, including oesophagoscopy, revealed no abnormality and he was discharged with a diagnosis of cardiospasm.

His past history revealed that a left empyema had been drained in 1915 and a transurethral resection of the prostate had been performed in 1946.

X-ray examination showed a carcinoma of the lower end of the oesophagus and cardiac end of the stomach. The blood pressure was 150/110, haemoglobin value 84%, blood urea 46 mg. per cent. Obstruction was sufficient to prevent a Ryle's tube being passed into the stomach for aspiration.

Operation, July 17th. Anaesthesia: Nitrous oxide-Oxygen-Ether. An abdomino-thoracic approach, using Garlock's type of incision, which extended into the 8th intercostal space, was used. An extensive carcinoma of the cardia infiltrating the oesophagus was found. Glands near the cardia and coeliac axis were enlarged. The lesser curvature was so involved that less than a total gastrectomy and a lower oesophagectomy would have been useless.

Total gastrectomy was performed and a loop of jejunum was anastomosed to the oesophagus in the chest. An anastomosis was made between the afferent and efferent loops of jejunum below the stoma and a jejunostomy made to allow for early feeding. An underwater drainage tube was inserted through the 9th intercostal space.

The patient's course was comparatively smooth and his subsequent progress satisfactory. He gained weight and had no difficulty with his meals. Unfortunately at the end of six months he was re-admitted with advanced intestinal obstruction. Laparotomy revealed that the terminal ileum was adherent to a caseating lymph gland. Post-mortem examination revealed the presence of chronic pulmonary tuberculosis with cavitation. The stoma at the site of the oesophageal anastomosis showed no constriction.

#### CASE 2. *Total Gastrectomy.*

J.H., male, aged 70, was admitted to the Royal Prince Alfred Hospital on July 17th, 1947. Ten months previously the patient noticed that raw fruit gave him hiccough and indigestion. Gradually other foods began to cause the same symptoms as well

as also causing retrosternal pain. He was nauseated, but had not vomited and had lost 35 pounds in weight in nine months.

Examination revealed obvious loss of weight. A mass could be palpated beneath the left rectus muscle just below the costal region. The haemoglobin value was 90%, blood urea 45 mg. per cent. and the highest reading of the urea concentration test 1.40. X-ray examination confirmed the diagnosis of carcinoma of the stomach.

Operation, Aug. 6th. Anaesthesia: Cyclopropane-Oxygen-Curare. Garlock's type of incision was used, extending into the 8th intercostal space. Laparotomy revealed an extensive carcinoma of the stomach with many adhesions to the posterior abdominal wall which necessitated removal of the spleen.

Total gastrectomy was performed with oesophago-jejunosomy and enteroanastomosis. A jejunostomy was made to allow for early feeding. His condition at the end of the operation was not good, and two days later had deteriorated further.

He developed moist sounds all over his chest and X-ray examination showed consolidation at the right hilar region. Aspiration bronchoscopy was performed twice, but on Aug. 10th he died.

At autopsy there was an extensive bilateral lobar pneumonia of both upper lobes and the right middle lobe. Suture lines were intact and there was no evidence of peritonitis. No metastases in the liver and no enlarged lymph glands could be found. The kidneys were polycystic and the aorta atheromatous. Microscopic examination of the lungs showed extensive pneumonia which was largely of the fibrinous type, but many of the plugs of fibrin contained what appeared to be clumps of organisms, suggesting the possibility of septic pneumonia.

This patient was a very poor risk and the growth was extensive and adherent. It is doubtful whether he should have been operated upon. After this case more care was taken with the prophylaxis for pulmonary complications.

#### CASE 3. *Total Gastrectomy.*

A.C., male, aged 64, was admitted to the Royal Prince Alfred Hospital on Jan. 8th, 1948. The patient was quite well until five years before, when he developed epigastric pain and discomfort after meals. During the last three years he had lost 21 pounds in weight, he had vomited frequently and had completely lost his appetite. His father had died at the age of 72 from a growth in the bladder and his brother had died from carcinoma of the liver.

He was very thinly built and the loss of weight was obvious. There was tenderness in the epigastrium and in the left hypochondrium, where a palpable mass was present. X-ray examination revealed an extensive infiltration of the body of the stomach by carcinoma.

Operation, Feb. 21st. Anaesthesia: Nitrous oxide-Oxygen-Myanesin-Pentothal. An abdomino-thoracic approach through the 8th intercostal space was used. An extensive carcinoma of the stomach

was found, involving the greater curvature and fundus and extending to the oesophageal opening. No visible metastases were found in the liver, although some enlarged glands were present on both curvatures.

Total gastrectomy was performed, the jejunum being anastomosed to the oesophagus; entero-enterostomy and jejunostomy were also done. An underwater drainage tube was inserted through the 9th intercostal space.

Pathologist's report: The specimen shows adenocarcinoma of the stomach and glands.

His convalescence was somewhat slow, but he has progressed satisfactorily. His appetite returned and he gained 35 pounds in weight. It is now fourteen months since his operation, and when seen recently he appeared very well.

#### CASE 4. Total Gastrectomy.

E.A., female, aged 55, was admitted to the Royal Prince Alfred Hospital on Jan. 22nd, 1948. She had been well until six months previously, when she began to lose her appetite, and on admission had complete anorexia. She had pain in the epigastrium and between the shoulders and had lost 28 pounds in weight.

On examination the loss of weight was obvious and a hard, well-defined tumour was palpable one inch below the left costal margin. X-ray examination showed a large filling defect on the lesser curvature of the stomach. Haemoglobin value was 58%, the blood urea 57 mg. per cent. Whole blood transfusions were given, and at the time of operation the serum protein was 6.7 g. per cent.

Operation, Feb. 11th. Anaesthesia: Nitrous oxide-Oxygen-Ether. An abdomino-thoracic approach through the 8th intercostal space was used, revealing a huge carcinoma of the stomach centred on the lesser curve.

Total gastrectomy was performed with oesophago-jejunosomy, enteranastomosis and a jejunostomy for feeding purposes. An underwater drainage tube was inserted through the 9th intercostal space. The tail of the pancreas and the spleen were resected with the growth.

Pathologist's report: The specimen consists of the whole of the stomach and contains a huge fungating tumour extending on to both the anterior and posterior walls. On the lesser curvature there are some very large lymph glands which are matted together. The growth is an adenocarcinoma with involvement of the lymph glands.

Her condition was satisfactory for four days, when she became breathless suddenly, and slightly cyanosed. Moist sounds were audible at both bases and she appeared to have early congestive cardiac failure. Her condition gradually deteriorated and she died on Feb. 17th. Autopsy revealed subacute necrosis of the liver and toxic myocarditis with a left pleural effusion.

This patient had a very advanced carcinoma which was freed from the posterior wall with difficulty.

Strangely enough, her post-operative condition for the first four days was better than that of previous cases.

#### CASE 5. Total Gastrectomy.

A.M., male, aged 63, was admitted to the Royal Prince Alfred Hospital on Feb. 19th, 1948. His symptoms were anorexia and pain in the epigastrium for three months. For two months he had complained of fullness in the epigastrium after meals. The pain became persistent and lasted most of the day. There was nausea, but no vomiting. He had lost 28 pounds in weight in two months.

On examination he was well built; the abdomen was large and adipose; no mass was palpable. X-ray examination revealed an extensive carcinoma of the stomach.

Operation, March 10th. Anaesthesia: Cyclopropane-Ether-Oxygen-Curare. Carlock's type of incision was used, extending into the 8th intercostal space. An extensive carcinoma of the stomach was found and considered operable.

Total gastrectomy was performed with an oesophago-jejunal anastomosis and an entero-enterostomy. Jejunostomy was done for feeding purposes. The underwater drainage tube was inserted through the 9th intercostal space. A Wangensteen's tube was passed through the anastomosis. Pathologist's report: The specimen shows a large carcinomatous ulcer high on the lesser curvature of the stomach extending along the curvature for 11 cm. and measuring 7 cm. in a transverse direction. Microscopically, the tumour proved to be a columnar celled adeno-carcinoma penetrating the whole thickness of the wall and extending into the surrounding fat.

As there had been some deflation of the cuffed Magill's tube, suction bronchoscopy was performed at the end of the operation. It was suggested that this patient should be postured with his head low to help maintain a clear airway, and this was agreed to. Unfortunately this allowed some intestinal contents to gravitate into the pharynx and be inhaled. The Wangensteen's tube with side holes so far along may have contributed to this, and a Levine's tube was used in later cases.

Suction bronchoscopy on March 12th revealed foul pus and bile. In spite of repeated bronchoscopy this patient died on March 17th.

Autopsy revealed gross congestion and patchy bronchopneumonia in the lungs. Small bronchi contained mucous and some material resembling gastric contents. There was no peritonitis. All suture lines were in excellent condition, with no trace of leakage. There was a large carcinomatous lymph gland one and a half inches in diameter in the superior mediastinum to the right of the superior vena cava.

#### CASE 6. Total Gastrectomy.

B.N., female, aged 64, was admitted to the Royal Prince Alfred Hospital on Feb. 27th, 1948, with a diagnosis of pernicious anaemia. This patient had been quite well until two years previously, when

she noticed increasing weakness and tiredness. This had been worse during the previous six months. The feet and ankles were swollen; there was anorexia and loss of weight, but no vomiting.

On examination, there was a marked pallor of the skin and mucous membranes. Epigastric tenderness was present, with a definite mass palpable. The blood pressure was 110/50, the red blood cells 2,390,000, white cells 3,250, haemoglobin value 39%. X-ray examination showed a constant filling defect on the greater curvature of the stomach at the junction of the middle and upper thirds.

Gastroscopy revealed a pale, thickened, infiltrated area in the middle third on the anterior wall and lesser curvature consistent with that seen in carcinoma. The posterior wall could not be visualised. The area was friable and bled easily.



FIG. II. Case 6. Total gastrectomy. The anastomosis can be seen in the highest portion of the film. The loop of jejunum is shown extending above the diaphragm.

Operation, March 31st. Anaesthesia: Nitrous oxide-Oxygen-Ether-Curare. An abdomino-thoracic approach through the 7th intercostal space was used. A large fungating carcinoma was found in the body of the stomach. Total gastrectomy with anastomosis of the jejunum to the oesophagus and entero-enterostomy were performed as well as jejunostomy. An underwater drainage tube was inserted through the 9th intercostal space.

Pathologist's report: The specimen shows a large fungating papillary carcinoma without involvement of the lymphatic glands.

Her convalescence was almost uneventful. It is now over a year since her operation. She has gained very little weight, but when seen recently, her condition was satisfactory. She had no difficulty with her food, but some regurgitation of bile.

#### CASE 7. Cardio-oesophagectomy.

J.V., male, aged 67, was admitted to the Royal Prince Alfred Hospital on March 24th, 1948. This patient was well until two years previously, when he developed pain in the epigastrium, at first occasionally, but gradually becoming worse. During the last eight months a dull ache had been present continuously in the epigastrium, made worse by meals, but relieved by vomiting. Regurgitation of fluid into the mouth took place at every meal. He had lost 70 pounds in weight in eight months. There had been no haematemesis or, as far as he was aware, melaena.

On examination there was marked loss of weight, he was tender in the epigastrium, but no mass was palpable.

Oesophagescopy revealed a neoplasm about 18 inches from the upper incisor level, resembling carcinoma, at the cardio-oesophageal junction. Biopsy showed the growth to be an adeno-carcinoma.

X-ray examination showed a carcinoma of the cardio-oesophageal region.

Operation, April 14th. Anaesthesia: Nitrous oxide-Oxygen-Ether-Cyclopropane-Curare. An abdomino-thoracic approach through the 7th intercostal space was used. A large growth involving the cardia and the oesophagus was mobilised with difficulty because the oesophagus was infiltrated for about two inches.

Cardio-oesophagectomy was performed and the residual stomach brought up and anastomosed to the oesophagus. A Levine's tube was passed through the anastomosis and an underwater drainage tube was inserted through the 9th intercostal space.

Pathologist's report: The specimen shows an ulcerating growth involving both the lower end of the oesophagus and the adjacent portion of the stomach and measures about 7 cm. in diameter. Microscopic examination shows adeno-carcinoma, but no involvement of the lymphatic glands.

His post-operative course was uneventful. He regained 35 pounds in weight. It is over a year since his operation, and when seen recently his condition seemed satisfactory, but his appetite had decreased somewhat.

#### CASE 8. Cardio-oesophagectomy.

E.H., female, aged 57, was admitted to the Royal Prince Alfred Hospital on April 4th, 1948. She had been well until May, 1947, when she experienced intermittent attacks of epigastric pain and discomfort accompanied by vomiting, especially after a heavy meal. During August, 1947, she had noticed a sudden change for the worse. During January, 1948, she developed severe left subcostal pain associated with pain in the left shoulder. During the three weeks prior to admission she had vomited frequently. At the time of admission the vomiting was persistent. She had lost 42 pounds in weight.

On examination she was pale and the loss of weight was obvious. She was retching and regurgitating small amounts of saliva. There was no abdominal tenderness. Haemoglobin value was 79%, the serum protein 5.7 g. per cent and the blood urea 22 mg. per cent.

X-ray examination showed marked obstruction at the lower end of the oesophagus. The irregularity and deformity extended into the cardiac end of the stomach, suggesting a neoplasm of the lower end of the oesophagus.

Oesophagoscopy revealed a fibrous post-cricoid stricture which would admit only a 7 mm. bronchoscope. The stricture was dilated and a malignant growth at the lower end of the oesophagus was seen. A fine filiform dilator was passed with extreme difficulty. Biopsy revealed squamous carcinoma.



FIG. IIIa. Case 7. An extensive filling defect is shown in the lower oesophagus and upper stomach.

Operation, April 21st. Anaesthesia: Pentothal-Nitrous oxide-Oxygen-Ether-Curare. An abdomino-thoracic approach extending into the 6th intercostal space gave an excellent exposure. A fixed mass was found involving the cardio-oesophageal region and the lower oesophagus. The growth involved the left lobe of the liver and the glands on the lesser curvature were infiltrated.

Cardio-oesophagectomy was performed, removing the left lobe of the liver and most of the crura of the diaphragm. The aorta was not involved and was easily freed. About half the stomach and several inches of the oesophagus were removed. The remaining portion of the stomach was anastomosed to the oesophagus. An underwater drainage tube was inserted through the 9th intercostal space. Pathologist's report: The tumour is a squamous-

celled carcinoma of the oesophagus, invading the adjacent portion of the stomach. The lymph glands are not involved.

Convalescence was very satisfactory. She gained very little weight in the next twelve months, but when seen recently she appeared well.

#### CASE 9. Cardio-oesophagectomy.

T.J.Y., female, aged 52, was admitted to the Royal Prince Alfred Hospital on May 7th, 1948, with a history of intermittent attacks of epigastric pain and nausea during the previous three years. The pain radiated through to the back between the shoulders. An attack might last three weeks. The last attack, seven weeks ago, was very severe and accompanied by vomiting. Nothing relieved the pain, which had no definite relation to food; the appetite was good and there was no loss of weight.



FIG. IIIb. Case 7. Cardio-oesophagectomy. The anastomosis between the oesophagus and residual stomach is shown clearly with an ample stoma.

On examination the patient appeared moderately well nourished. There was tenderness in the left hypochondrium, but nothing abnormal palpable.

A fractional test meal showed no free acid and low combined acid. X-ray examination revealed a large ulcer high on the posterior gastric wall near the lesser curvature. It was considered that the lesion might be malignant.

Operation, May 19th. Anaesthesia: Nitrous oxide-Oxygen-Ether-Curare. An abdomino-thoracic approach through the 7th intercostal space was used. There was a large chronic ulcer on the posterior wall of the stomach about  $\frac{3}{4}$  inch below the oesophagus. It was indurated and considered probably malignant.

Cardio-oesophagectomy was performed, the upper half of the stomach being removed. A Levine's tube was passed through the anastomosis and an underwater drainage tube inserted through the 9th intercostal space.



FIG. IVa. Case 8. Squamous carcinoma of the lower oesophagus involving the stomach.



FIG. IVb. Case 8. Cardio-oesophagectomy. In this case it was necessary to mobilise the duodenum to allow the pylorus to be brought up to the level of the diaphragm.

Pathologist's report: The lesion is a chronic peptic ulcer with no evidence of carcinoma.

Her convalescence was uneventful. She has remained well and free of symptoms.

#### CASE 10. Cardio-oesophagectomy.

J.McL., female, aged 78, was admitted to the Royal Prince Alfred Hospital on Sept. 2nd, 1948, complaining of difficulty in swallowing solids and thick fluids for three months. This disability had increased very much recently and she had lost 28 pounds in weight. For her age her general condition was reasonably good. X-ray examination indicated a carcinoma involving the distal two and a half inches of the oesophagus.

Oesophagoscopy showed the upper part of the constriction about 13½ inches from the incisor teeth. It was impossible to pass any bougie.

The haemoglobin value was 95%, the blood urea 34 mg. per cent, the serum protein 6.5 g. per cent and the blood pressure 104/85.

Operation, Sept. 21st. Anaesthesia: Pentothal-Cyclopropane-Oxygen-Curare. An abdomino-thoracic approach with a Garlock's type of incision extending into the 7th intercostal space was used. The growth was found at the cardio-oesophageal junction, involving about 3 inches of the oesophagus and about 2 inches of the stomach. No obvious glands were palpable on the lesser curvature and no secondary masses detected in the liver. Cardio-oesophagectomy was performed and a Levine's tube passed through the anastomosis.

Pathologist's report: Specimen shows a squamous carcinoma of the oesophagus involving the cardiac portion of the stomach.

Her convalescence, in spite of her age, was uneventful. Undoubtedly the intrabronchial penicillin used pre-operatively prevented pulmonary complications. At the end of four months she developed a small fungating tumour in the scalp. This was excised and the pathologist reported that it was a squamous epithelioma which appeared to be primary.

It is now seven months since her operation, and although she has gained very little weight, she has no trouble when swallowing food. It is most probable that the epithelioma on the scalp was a metastasis.

#### CASE 11. Total Gastrectomy.

J.A.H., female, aged 58, was admitted to the Royal Prince Alfred Hospital on Oct. 4th, 1948. During the previous two years the patient had become progressively more tired and suffered from epigastric discomfort and waterbrash, with, however, very little pain. There had been no vomiting, but the appetite was very poor. She had lost 14 pounds in twelve months. At the age of 22 she had had a haematemesis, and when 52 had had a melaena supposedly due to a peptic ulcer.



Examination showed a rather emaciated woman with a large palpable mass in the left upper abdomen. Rectal examination was negative. X-ray examination demonstrated an advanced carcinoma involving practically the whole of the body of the stomach.

The haemoglobin value was 85%, the serum protein 6.0 g. per cent and the blood urea 38 mg. per cent.

Operation, Oct. 12th. Anaesthesia: Pen'othol-Oxygen-Ether. Laparotomy was done, using a transverse incision. An enormous carcinoma was found, involving most of the stomach and involving the left transverse colon up to the splenic flexure.

A subdiaphragmatic total gastrectomy was performed, removing the left portion of the transverse colon and the splenic flexure with the growth. A loop of jejunum was anastomosed to the oesophagus and an entero-anastomosis performed. To save time the colon was resected by the Paul-Mikulicz method. The spur colostomy was brought out into the left iliac fossa. A Levine's tube was passed through the oesophageal anastomosis.

Pathologist's report: The specimen consists of the whole of the stomach and a large portion of the transverse colon. The wall of the stomach is greatly thickened. The tumour is a carcinoma and is highly cellular in most parts. In a section which includes part of the colon some of the growth is seen to be invading the outer part of the muscle.

Her convalescence was very good for eight days, when she suddenly developed an acute intestinal obstruction. At laparotomy on Oct. 22nd it was found that the whole of the small intestine had twisted round the descending limb of the colostomy. This was rectified with difficulty and the lower limb fastened to the anterior abdominal wall with a few interrupted sutures. In spite of this complication, her convalescence continued to be satisfactory and she was out of bed on Nov. 2nd.

Her blood coagulation times had been low since the second operation, in spite of anti-coagulants. It was thought that the batch of heparin used might have been at fault. She died suddenly on Nov. 4th, while sitting in bed, from a massive pulmonary embolus.

At autopsy, in the bifurcation of the main pulmonary artery, there was an ante-mortem thrombus which extended a short distance into the right and a considerable distance into the left pulmonary artery. The clot was not adherent to the vessel wall. A thrombus was present in the upper portion of the right internal iliac vein. The upper portion of this clot was adherent to the vessel wall. There was no peritonitis and no ascites. All suture lines were intact. The colostomy presented the usual appearance and no leakage had occurred in this vicinity.

It is considered that if a primary anastomosis had been done when the colon was resected, the patient might have survived.

## CASE 12. Total Gastrectomy.

E.D., male, aged 64, was admitted to the Royal Prince Alfred Hospital on Jan. 3rd, 1949. He had suffered from epigastric pain intermittently for twelve months. The pain had been constant for the last three months with a sensation of fullness. He had had no appetite for the past month, but there had been no vomiting and very little flatulence. He had suffered from dysphagia intermittently since 1923.

On examination there was a palpable mass in the epigastrium. A fractional test meal showed hypochlorhydria. X-ray examination revealed a large filling defect arising from the lesser curvature proximal to the incisura angularis, the appearances being those of carcinoma. Gastroscopy showed a cauliflower-like mass on the anterior wall of the stomach extending to the lesser curvature and reaching the posterior wall. It was considered to be an encephaloid carcinoma.

Operation, Feb. 3rd. Subdiaphragmatic total gastrectomy was performed, using a transverse abdominal incision. There was a large infiltrating mass extending almost the entire length of the lesser curvature from the incisura angularis to the cardia. Regional lymph glands were enlarged and a large gland was excised from the upper margin of the pancreas. Retrocolic oesophago-jejunostomy was performed together with an entero-enterostomy and a Levine's tube passed through the anastomosis.

Pathologist's report: The stomach is occupied by a large infiltrating carcinomatous ulcer which measures 12 cm. in diameter. The tumour is very cellular; lymphatic glands show metastatic carcinoma.

His early convalescence was good, but on Feb. 10th the blood coagulation time fell to a sustained level of two minutes and he was given heparin and dicumarol. In spite of this, on Feb. 15th he developed a right pulmonary thrombosis. On Feb. 17th he developed a haematoma in each rectus sheath adjacent to the wound. These were evacuated and the wound re-sutured. On Feb. 26th he had a further right pulmonary thrombosis, and heparin and dicumarol were given again. His condition on discharge was very satisfactory, and when seen on April 20th he was taking food without any difficulty and felt very well.

## CASE 13. Cardio-oesophagectomy.

S.R.R., male, aged 55, was admitted to the Royal Prince Alfred Hospital on Jan. 20th, 1949. He had been well until eighteen months previously, when he began to experience a full feeling after meals. During the last six months there had been progressive loss of weight and he had been treated at another hospital for ulcer. Three months previously he had developed a severe pain in the left hypochondrium not related to meals. His appetite was fair and there had been no vomiting, but he had lost 42 pounds in weight in the previous eighteen months.

X-ray examination showed a filling defect at the cardiac end of the stomach and narrowing of the distal oesophagus. The appearances were those of an extensive carcinoma with some dilation of the



oesophagus above the lesion. There was some tenderness in the left hypochondrium, but nothing abnormal palpable. A fractional test meal showed achlorhydria. Gastroscopy revealed a mechanical block at the cardio-oesophageal area.

Operation, Feb. 23rd. Anaesthesia: Pentothal-Cyclopropane-Oxygen-Curare. A transverse upper abdominal incision was used for laparotomy. A hard growth was found in the cardia infiltrating the oesophagus and adherent posteriorly. Some glands at the upper margin of the pancreas were enlarged, but there was no obvious secondary involvement of the liver. The incision was extended into the 7th intercostal space. The growth was mobilised with difficulty and cardio-oesophagectomy was performed, but two-thirds of the stomach had to be removed. The remaining portion of the stomach was anastomosed to the oesophagus, a Levine's tube passed through the anastomosis and an underwater drainage tube inserted through the 9th intercostal space.

His post-operative condition was satisfactory and his lung was fully expanded. The following day the underwater drainage tube, which was shorter than usual and had been fastened to the side of the bed, had been pulled through the incision, allowing the left lung to become completely collapsed. This was rectified and every possible effort made to expand the lung, including repeated bronchoscopy and the use of the anaesthetic machine and a cuffed tube, but he died on Feb. 27th.

Autopsy showed that the left lung was completely collapsed and adherent to the diaphragm. It was completely airless, but the bronchi contained some bloodstained mucus. Suture lines were intact. The head of the pancreas was firm and some carcinomatous lymph glands were behind it and also along the aorta.

Although this resection was palliative and the patient in poor condition, the cause of his death was unfortunate. This was the only death following 5 cases of cardio-oesophagectomy.

#### SUMMARY.

Records of 13 patients submitted to total gastrectomy or cardio-oesophagectomy are presented.

Eight patients survived operation, one dying at the end of six months from acute intestinal obstruction.

Seven patients are still living, 4 having survived for a period of at least twelve months.

A plea for early diagnosis has been made because all these patients had advanced malignant disease and some were poor risks.

The operability rate has been extended as far as possible. With earlier diagnosis and increasing experience, it is felt that the mortality can be lowered.

These extensive operations may be considered justifiable if the patient can live in comparative comfort for a year or more.

#### ACKNOWLEDGEMENTS.

Grateful acknowledgment is made to Dr. W. I. T. Hotten, Senior Honorary Anaesthetist at the Royal Prince Alfred Hospital, for his help in these cases. He has given the majority of the anaesthetics and has been most helpful with the pre- and post-operative care of the patients. I am also indebted to Mr. E. A. M. Reddel, who has assisted me at most of these operations, for his many helpful suggestions.

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#### ADDENDUM.

Since this article was accepted for publication there have been 2 more successful cases. One patient was a woman aged 63 who required a total gastrectomy for an extensive carcinoma of the stomach involving the pancreas. The other patient was a man aged 29, on whom a cardio-oesophagectomy was performed for a cardio-oesophageal carcinoma.

## FLEXOR TENDON REPAIR IN THE HAND.

By B. K. RANK and A. R. WAKEFIELD.

Melbourne.

**F**EW surgeons have seen any successful results from the repair of flexor tendons of the hand when these tendons are severed within the digital sheaths. Because of this and, no doubt, because of adverse experiences with these cases, they are inclined to consider that injuries of flexor tendons in this region are hopeless.

Our main object in publishing this short paper is to help change this outlook. Moreover, by setting out our results we hope to provide a standard in this country for those interested in this work.

Until a few years ago surgeons applied to the problem of tendon repair much the same principles and methods as they did to gross surgery in other parts of the body. In the case of extensor tendons in general, and possibly flexor tendons outside the digital sheaths, a variable degree of functional recovery was usually seen. But even in these situations gross methods rarely produced a complete return to normal, and in the case of flexor tendons in the finger—never. It was not until a few years ago, when certain surgeons, notably Sterling Bunnell and his associates, devoted themselves to a careful study of the anatomical peculiarities of the region and to the development of a higher order of atraumatic technique, that a few successful results began to appear. These gave some encouragement to the many who had almost abandoned hope in this field, and to some who were prepared to advise that amputation was the only answer to the problem.

The principles laid down by Bunnell and others are comprehensive, and it is our purpose only to elaborate them by reference to our series of some 71 flexor tendon repairs carried out in Melbourne over the last few years.

We are sure that of all the factors concerned in successful tendon surgery, meticulous attention to the most elaborate atraumatic technique is the most important. Failure to observe this by operating under

adverse conditions without the proper instruments, materials and assistance will result only in failure. We have not seen a successful flexor tendon repair distal to the metacarpo-phalangeal joint carried out in the Casualty Department of a General Hospital, although thousands of such operations must have been performed; nor do we expect to. If surgeons will realize this and be content under such conditions to concentrate on as perfect a skin repair as possible, leaving the tendon repair until optimum conditions are available, success will be much nearer.

There are three lines of approach to the immediate problem of a severed flexor tendon:—

- (1) Primary direct repair.
- (2) Delayed direct repair.
- (3) Delayed tendon graft.

### (1) *Primary direct repair.*

Provided that adequate facilities and equipment are available, that one is dealing with an incised wound which is relatively clean, that the injury is confined to soft tissue without tissue loss and is of only a few hours duration, this is the method of choice in all cases except those occurring between the metacarpo-phalangeal joint and the insertion of the flexor digitorum sublimis.

Where these conditions do not prevail, primary repair of a tendon should not be attempted because a failed primary repair which results in scar fixation and usually a fixed flexion deformity rarely lends itself to any further surgery.

If a primary repair is decided upon, only the profundus tendon should be sutured and the two ends of the sublimis tendon removed for a sufficient distance to ensure that both ends are well clear of the operative field. There are two reasons for this. Firstly, a fully functioning profundus tendon will by itself produce a functional result which can be distinguished from normal only in the last few degrees of the final "wind-up" in finger flexion, and this has no effect on the

every-day use of the hand. Secondly, if both tendons are repaired at the same point, adhesion between the suture points will prevent their independent function and, although flexion at the proximal interphalangeal joint may be complete and powerful, independent flexion at the terminal joint is often lost by this procedure. It is true that occasionally cases are seen where both tendons function well, especially in children, but, for the

reasons given, it has become sound practice to confine attention to the profundus tendon only.

Within the digital sheath between the commencement of the specialized tunnel in the region of the metacarpo-phalangeal joint and the insertion of the sublimis tendon, the position is somewhat different. Here, a rigid tube closely surrounds the two tendons; this is the region where, in the past, failure has nearly always occurred as a result of dense adhesion between the site of repair and the digital sheath. In spite of this, however, we have obtained successful results by primary direct repair of the profundus tendon after excision of the sublimis and all the overlying sheath in the region of the suture line, preserving only a small area of sheath, well away from the point of suture, to act as a pulley and prevent prolapse of the repaired tendon. There are many who advocate this procedure, but it is now our opinion that, except in young children, results in this region are not so satisfactory for primary direct repair as when a secondary grafting operation is carried out.

#### (2) *Delayed direct repair.*

In the absence of the requisite conditions for primary tendon repair, the skin should be closed meticulously after a wound toilet of a conservative nature. Delayed direct repair, if indicated, can then be undertaken as soon as the wound is healed and the tissues are sufficiently mobile. In the intervening period the joints can be kept mobile by gentle passive movements. The operation, however, should not be delayed longer than a few weeks because after that time the tendon ends are so contracted that satisfactory direct suture is impossible.

#### (3) *Delayed tendon graft.*

This procedure is indicated where primary repair has not been undertaken for a variety of reasons and the time interval is so long that contraction of the ends of the tendon makes direct suture impracticable — i.e., any time after about six weeks.

We now consider this to be the method of choice also in all cases excepting young children, no matter how favourable the conditions, if the tendons are divided in the hazardous region between the metacarpo-



FIG 1. Primary direct repair left little finger over the proximal phalanx. (90-100% recovery)

phalangeal joint and the insertion of the sublimis tendon. In this particular area the tendon grafting procedure has one major advantage, in that it provides a complete length of undamaged tendon (surrounded by its own paratenon) passing without interruption from the proximal palm to the distal phalanx — i.e., through that area where rigid adhesions to a sutured tendon are so common. This, we consider, outweighs the disadvantages of two operations several weeks apart and the more extensive dissection that is involved. However, this view is controversial, and we have not yet had sufficient experience to be dogmatic about it.



FIG. II. Delayed direct repair right flexor pollicis longus in the region of the proximal phalanx. (90-100% recovery). (Operation by Mr. F. W. Connaughton).

The tendon grafting procedure involves the removal of both tendons from the proximal palm to their insertions, leaving only a very short stump of the profundus near its insertion, to which the graft may be sutured. The graft can be taken from any one of a number of sources, such as the flexor digitorum sublimis from forearm to

point of division, the long extensors to the second, third or fourth toes, or the palmaris longus. Our preference is for the palmaris longus because it is a thin tendon which can be obtained with plenty of surrounding paratenon within which it can glide freely. This graft is then laid from either the flexor sublimis or profundus in the proximal palm to the distal phalanx, after excision of the entire digital sheath, with the exception of two narrow pulleys, one over the proximal and one over the middle phalanx.

Delayed tendon grafting should be carried out as soon as practicable after healing and softening of the primary wound and before gross atrophy and fibrosis develop in the corresponding muscle bellies. If a long period of time has elapsed, it is generally regarded as better to anchor the graft proximally to the sublimis tendon of a neighbouring finger after dividing that tendon in the proximal palm. We do not know what is the optimum period of time which should elapse before the adoption of this modification. However, we have used the original divided tendons successfully after varying periods up to eighteen months, and although recovery after operation has been a little slower, it has been no less complete even at this late stage.

So far we have dealt with division of both flexor tendons, but sometimes only one is divided. If the sublimis is divided in the palm or base of the finger and the profundus is functioning normally, there is no indication for any interference with the tendons. Beyond the point over the proximal phalanx where the two elements of the sublimis tendon diverge, the profundus tendon alone is often severed. If this division is well distal and a primary repair is carried out after the excision of the distal half of the tendon sheath, satisfactory results can be obtained, but if the division is in the region of the proximal interphalangeal joint, the suture point in the tendon will not pull through the tunnel formed by the two portions of the sublimis. It will become adherent at this point, giving a stable, but immobile, distal interphalangeal joint. Such a condition does not cause any great disability and until a state of affairs develops where uniform success is assured, it seems as yet unreasonable to jeopardize a fully

functioning proximal interphalangeal joint in the hope that a tendon graft will produce full function of both joints.

(c) Only the finest and most delicate instruments should be used and handling of the tissues should be reduced to the minimum.

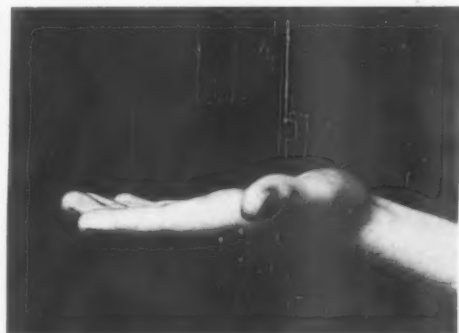


FIG. III. Secondary tendon graft left middle finger following failed primary repair. (90-100% recovery).

FIG. IV. Delayed tendon graft left middle finger following primary skin repair only. (50-80% recovery).

The following points concerning the operative technique involved in tendon repair are worthy of special mention:—

(a) A tourniquet is essential to ensure a bloodless field, at least during the stage of dissection.

(b) The placing of the skin incisions is of extreme importance; no longitudinal finger incisions should ever come further forward than the lateral limits of the flexion creases; no incision should ever be continuous from palm to fingers, and all incisions in the palm should be transverse or oblique and not longitudinal. With these provisos, the number of incisions can be varied to fit the case. These principles, of course, apply to the surgery of the hand in general, but they are most important.

(d) Many different suture materials and types of stitching have been used with success and with failure, and there is little to choose between many of them. But whether wire or silk is used, whether the stitches are buried or Bunnell's pull-out technique is employed, it is not the type of stitch that matters nor the particular way in which it is placed, so much as the amount of trauma involved in its insertion. It is useless to use fine silk if it is threaded on a heavy needle with a large eye which is driven vigorously through the tendon held between the teeth of a pair of heavy forceps. The amount of reaction and fibrosis is proportional not so much to the suture material, as to the manner of inserting it.

(e) The position in which the hand is immobilized is of great importance. When

TABLE NO.1  
FLEXOR TENDON REPAIRS FROM WRIST TO FINGER TIP

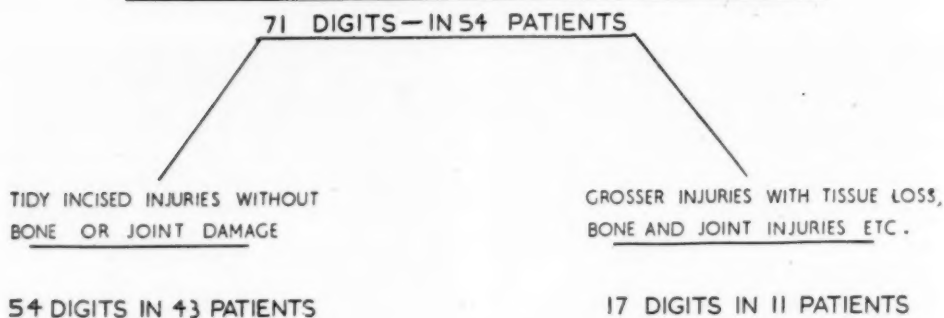


TABLE NO.2  
TENDON REPAIRS IN INCISED TIDY INJURIES  
54 DIGITS - IN 43 PATIENTS.

<u>THUMB—12</u>		<u>OTHER FINGERS—42</u>		
GOOD—better than 45°	5			
MODERATE—20° to 45°	2			
POOR—0° to 20°	1			
INCOMPLETE	1			
NOT TRACED	3			
		<u>PROXIMAL TO M.P. JOINT</u>	<u>MP JOINT TO SUBLIMIS INSERTION</u>	<u>DISTAL TO SUBLIMIS INSERTION</u>
GOOD	90%—100%	5	9	—
MODERATE	50%—80%	4	8	1
POOR	0%—50%	—	6	3
INCOMPLETE	—	—	4	—
NOT TRACED	—	2	—	—
		11	27	4

direct suture of the tendon is employed, there is no difficulty in ensuring the correct amount of tension in the tendon, but when using a tendon graft, the length of graft used is just sufficient to produce light tension when the wrist is semi-flexed and the metacarpo-phalangeal and interphalangeal joints are each in about thirty degrees flexion. This is the position in which the hand should be finally immobilized. Only with experience can one learn to assess normal tendon

tension. Each finger has a typical flexion posture in the anaesthetized subject and this must be reproduced when tendon continuity is restored by a graft. Moreover, when the operation is completed, the finger should extend and flex when the wrist is flexed or extended, as it normally would.

(f) Much difference of opinion exists concerning the period of immobilization after operation. We have always adhered to Koch's (1944) teaching, following on the



work of Mason and Allen (1941), that no movements should be allowed until the period of optimum compromise between subsiding reaction and tendon union beginning to consolidate. This does not occur until the third week. At this time active movements within the inner range are commenced, but restraint is still continued until sound union is established at the end of about five weeks.

Pulvertaft (1948), on the other hand, working at Derby in England, has produced an excellent series of cases and advocates limited active movements after the second day, relying on his sutures to maintain apposition until tendon union is complete. We think that this policy is unsound basically, and we have yet to be convinced that it gives, as he claims, a higher proportion of successful results.

It is important to remember that progress comes slowly when the immobilization period is over. At first only a few degrees of movement can be seen, and improvement gradually occurs over the succeeding weeks. The final results should never be anticipated in under six months and further improvement is often not seen for long after.

Throughout we have assumed that we are dealing with cases of severed flexor tendons as an isolated injury without soft tissue

mangling or loss and without bony damage—i.e., the clean, tidy, incised type of wound. In such cases the prognosis, following the lines of treatment described, has vastly improved over the last few years and will go on improving with further refinements in technique. The figures set out in the tables are over-all figures of our own cases. They do not demonstrate the gradual improvement in prognosis that has occurred with increasing experience, but we can state that success was very rare at first, whereas in the last two years the percentage of satisfactory results has been much better than the over-all figures indicate. Coincidental digital nerve damage is common. This should be respected and dealt with on its merits, but in our opinion should not influence the management of the tendons.

The more extensive, irregular and mangling the associated tissue damage, the worse the prognosis of the tendon injury becomes. In an isolated finger injury coincidental bone and joint damage, particularly intra-articular fracture, make the prospect of tendon recovery so remote that primary amputation is often the best treatment. However, where more than one finger is involved, even a few degrees of active flexion will make or mar the function of the hand, and if a tendon repair can offer even this, it can be of great value.

TABLE NO.3  
FLEXOR TENDON REPAIR IN INJURIES WITH SOFT TISSUE LOSS  
EXTENSIVE SCARRING, BONE & JOINT DAMAGE ETC.  
17 DIGITS - IN 11 PATIENTS.

SINGLE FINGER INJURIES—6			PART OF A GROSS HAND INJURY—11		
GOOD	- 90%—100%	—	MODERATE IMPROVEMENT - 50% -		3
MODERATE	- 50% - 80%	3	SMALL IMPROVEMENT		
POOR	- less than 50%	3	WITH FEW DEGREES USEFUL FLEXION		6
			NO IMPROVEMENT		2

TABLE NO.4

TOTALS

<u>TIDY WOUNDS</u>		<u>GROSS INJURIES</u>	
GOOD	19	GOOD	—
MODERATE	15	MODERATE	6
POOR	10	POOR	11
INCOMPLETE	5	INCOMPLETE	—
UNTRACED	<u>5</u> 54	UNTRACED	<u>—</u> 17

GRAND TOTAL 71SUMMARY.

1. A brief account is given of the modern approach to flexor tendon repair.
2. Some of the technical considerations involved are discussed.
3. A tabled summary of the results of 71 cases is set out.

ACKNOWLEDGEMENT.

We pay a sincere tribute to the work of the physiotherapists in the institutions in

which these cases were managed, for without their enthusiastic co-operation much of our work would have been of no avail.

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# TUMOURS OF PERIPHERAL NERVES.

By R. A. MONEY.

(From the Department of Neurosurgery, Royal Prince Alfred Hospital, Sydney.)

THIS paper records the main clinical features in 153 patients with swellings on nerves or with severe pain associated with a localized swelling. All these conditions are regarded, for purposes of this paper, as tumours of peripheral nerves.

## FREQUENCY.

Excluding tumours of intracranial nerves, especially the 5th and 8th nerves, and intraspinal or "dumb-bell" tumours, only 146 verified cases of peripheral nerve tumours were found in the records of admissions to the Royal Prince Alfred Hospital, Sydney, from 1910 to 1948. During this period the total number of patients admitted was 360,672, so that the incidence was 1 in 2,470. If amputation and scar neuromata are excluded, the incidence is even less. In addition, 7 cases seen in private practice have been included in the series.

## CLASSIFICATION.

The conditions ranged from swellings on nerves, usually traumatic in origin, to tumours of a progressive and obviously neoplastic character. Glomus tumours, which suggest a nerve relationship because of the severe pain associated with them, are included.

### (A) SIMPLE.

(i) Nerve swellings (not neoplastic) ..	134
(a) Traumatic .. .. .	76
(b) Malformations .. .. .	24
(Multiple neuro-fibromatosis)	
(ii) Nerve swellings (neoplastic) ..	32
(iii) Non-nervous swellings .. .. .	2
(Glomus)	

### (B) MALIGNANT.

Various types .. .. .	19
	153

## DISTRIBUTION.

Whereas most of the traumatic "neuromata" occurred in association with nerves of the limbs, the other types occurred mainly on the trunk.

### (A) (i) Traumatic nerve swellings.

Of the 76, 38 have been classified as "amputation neuromata", 34 as "painful operation scars" and 4 as "interdigital neuromata", distributed as follows:

#### Amputation neuromata:

Axilla .. . . .	3
Arm .. . . .	11
Forearm .. . . .	3
Fingers .. . . .	7
Thigh .. . . .	5
Leg .. . . .	4
Other sites .. . . .	5
	— 38

(17 of the above patients were ex-soldiers of World War I)

#### Painful operation scars:

Arm .. . . .	4
Hand .. . . .	3
Fingers .. . . .	7
Thigh .. . . .	6
Leg .. . . .	6
Abdominal or chest wall ..	3
Other sites .. . . .	5
	— 34

(6 of the above patients were ex-soldiers of World War I)

#### Interdigital neuromata:

Between 3rd and 4th metatarsals .. . . .	4
	— 76

#### Malformations (multiple neurofibromatosis):

Widely distributed on the trunk .. 24

### (ii) Neoplastic (non-malignant) nerve swellings.

#### Single neurofibroma:

Limbs .. . . .	9
Scalp .. . . .	1
Face .. . . .	1
Tongue .. . . .	1
Chest wall .. . . .	1
Lung .. . . .	2
Auerbach's plexus of intestine .. . . .	1
Posterior abdominal wall ..	1
	— 17

#### Schwannoma (neurinoma):

##### (a) of nerve trunks:

Suprascapular nerve ..	2
Median nerve .. . . .	2
Radial nerve .. . . .	1
External popliteal nerve	2
	— 7

## (b) of subcutaneous or sub-mucous regions:

Face .. . . .	1
Stomach wall .. . . .	1
Axilla .. . . .	1
Forearm .. . . .	1
Thigh .. . . .	1
Leg .. . . .	1
—	6

Angio-neuroma (position not recorded) .. . . .	1
Myxo-neuro-fibroma (position not recorded) .. . . .	1

(iii) *Non-nervous swellings (Glomus).*

Sole of foot .. . . .	2
—	34
	134

(B) *Malignant.*

## (a) Neurogenic sarcoma:

Neck .. . . .	3
Vagus nerve .. . . .	2
Cheek .. . . .	1
Axilla .. . . .	1
Arm .. . . .	1
Thigh .. . . .	1
—	9

## (b) Neurogenic fibrosarcoma:

Abdominal wall (desmoid-type) .. . . .	2
Thigh .. . . .	2
Clavicle .. . . .	1
Axilla (ulnar nerve) .. . . .	1
—	6

## (c) Schwannoma:

Nerve sheath of sciatic nerve .. . . .	1
Nerve sheath posterior tibial nerve .. . . .	1
—	2

## (d) Myxo-neuro-sarcoma:

Shoulder region .. . . .	1
Leg .. . . .	1
—	2
	19
	153

## THE OCCURRENCE OF PAIN AND ITS DISTRIBUTION.

In all cases of traumatic and amputation neuroma, and of painful scars with small neuromata, pain associated with tenderness was the leading symptom. In many cases, there were associated vasomotor and trophic changes, resulting in conditions now referred to as causalgia and erythromelalgia, with constant burning, boring pains of widespread distribution and, in the case of amputations, often "referred" to the phantom limb. The pains were made worse by pressure and heat. Pressure or touch upon the neuroma caused pain in the distribution of the nerve as well as locally.

Among the other types of tumour, pain was a surprisingly inconstant symptom, as can be seen by the following table:

Type of tumour	No pain	No tenderness	Lump only	Total number of cases	Percentage of cases without pain
Multiple neuro-fibromatosis (Von Recklinghausen's disease) .. . . .	17	15	15	24	70
Neurofibroma .. . . .	8	9	8	17	47
Schwannoma (Neurinoma) of nerve trunks .. . . .	2	3	2	7	28
Schwannoma (Neurinoma) (subcutaneous and submucous) .. . . .	2	2	2	6	33
Myxo-neuro-fibroma .. . . .	1	1	1	1	100
Angio-neuroma .. . . .	1	1	1	1	100
Neurogenic sarcoma .. . . .	5	5	5	9	55
Neurogenic fibrosarcoma .. . . .	3	3	3	6	50
Myxo-neuro-sarcoma .. . . .	2	2	2	2	100
TOTALS .. . . .	41	41	39	73	56

In most of these cases without pain, the tumours were situated in the trunk. When pain was present, it had a sharp, shooting character referred to the distribution of the affected nerve or nerves in the distal portions of the extremities, or else it was a dull, constant ache, with "pressure". Paraesthesia and allocheiria were frequently noted, and often their distribution was remarkably selective, as in one patient who had a neurofibroma of the radial nerve at its origin in the axilla, which caused pain and paraesthesia referred only to its dorsal cutaneous branch in the forearm when certain movements were performed.

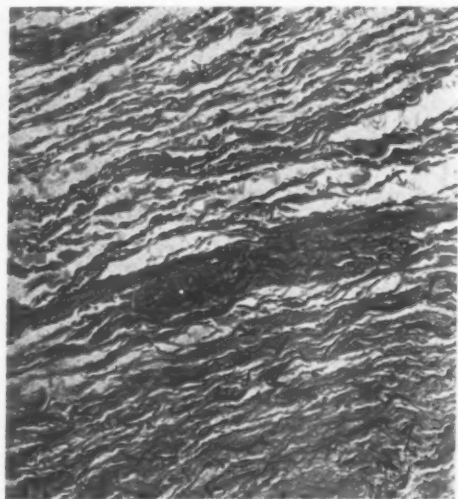


FIG. I. An interdigital "neuroma" showing overgrowth of fibrous tissue and separation of the fibres as though by oedema from chronic irritation. (x 100)

In another patient, pain was referred to the medial border of the forearm, and the medial two digits, with slight wasting of the muscles of the hand. The pain and wasting were at first thought to be due to pressure from a cervical rib which was clearly shown in a skiagram. This abnormality was dealt with surgically without relief, and it was only some three months later, when a mass was felt at the apex of the axilla, that the correct diagnosis was made. A neurogenic sarcoma of the upper end of the ulnar nerve was removed at an inter-scapulo-thoracic amputation, but the patient died about eighteen months later with a local recurrence and pulmonary metastases.

## SPECIAL FEATURES OF CERTAIN TUMOURS.

### *Interdigital Neuroma.*

This was first described by Betts (1940), but it has come into prominence again recently in the literature and is now recognised as the cause of metatarsalgia (Morton's disease or Morton's toe) (Moore, 1949). It is actually a hypertrophy with fibrosis in response to chronic and repeated trauma to one of the interdigital nerves in its intermetatarsal course, usually between the 3rd and 4th metatarsal bones (Fig. I). Although there are only 4 cases in the present series, all have been recorded since 1946. Excision has given immediate and lasting relief.

### *Multiple neuro-fibromatosis.*

The neurofibromata in Von Recklinghausen's disease were usually widely distributed. Many of these were painless and not tender; in only 5 cases did they cause any inconvenience.

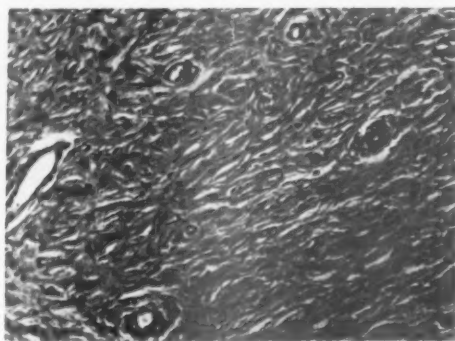


FIG. II. A simple neuro-fibroma of the skin, characteristic of the type found in Von Recklinghausen's disease. (x 100)

In 2 of these, there were associated intraspinal neuro-fibromata which extended widely both extra- and intra-durally, causing paraplegia. One of the tumours in the abdominal wall turned into a spindle-celled sarcoma and recurred several times despite wide removal.

In another instance there was associated a large plexiform neuroma of the lumbo-sacral region which extended inwards to the spinal column, but not into the dura mater. Some

of the tumours had undergone myxomatous degeneration. Their characteristic histology is fairly constant (Fig. II).

*The simple Schwannoma (Neurinoma).*

These were all large tumours with numerous cystic spaces in their substance (Fig. III) and occurred in the trunks of large nerves except for 2 on the supra-scapula nerve.



FIG. III. A simple type of Schwannoma showing palisading of the nuclei, Verocay bodies and a tendency to cystic degeneration. (x 100)

*Glomus tumours.*

These are rare. After a brief historical review, their pathological features and problems have been fully described recently by Lendrum (1947). He accepted the views put forward by Pierre Masson (1924) that those tumours, which had been regarded as peritheliomata or angiosarcomata, were, in fact, abnormalities of the little known dermal arterio-venous shunt or glomus. The glomus is a convoluted, modified arteriole communicating directly with a vein and by-passing the dermal capillary bed. This shunt vessel has a narrow channel and a thick medial coat composed of large cuboidal cells, the glomus cells, and there is a rich perivascular nervous network.

The common form is subungual and is a small cellular mass, not obviously angioma-

tous, but when found elsewhere, it is a well defined nodule about 1 cm. in diameter, situated in the lower layer of the dermis. Microscopically, all are angiomas with one common feature, the glomus cells (Figs. IVa and IVb). The connective tissue stroma of the central zone shows myxomatous degeneration, occasionally obvious neuro-fibromatous proliferation and, at times, myomatous overgrowth. This last feature is not unexpected, as, histologically, the glomus cells are proliferations of specialized muscular cells, present in the peculiar media of the shunt canal. The term "glomangioma" is thus given to the tumours, though Robertson (1939) suggested that "angiectom" should replace the term "angioma" and so "glomangiectom" would naturally follow.

These tumours are characterised by the extraordinary severity of the paroxysmal pain they produce, so that, even in the pre-anaesthetic days of those first described by Wood (1812), patients were willing to submit to any operation for their removal. Sometimes the nodule is present for years before the pain comes; in other cases the pain precedes the nodule and causes much trouble in diagnosis. The pain radiates distally and proximally and widely; "attacks" occur after a light touch and after temperature changes with increasing severity and radiation. Indeed, it is the same type of pain which Leriche (1939) attributes to disturbance of the sympathetic neuro-vascular mechanism. Where the lesion is subungual (the commonest, and almost invariably in women) the diagnosis is reasonably certain even in the absence of tumour and radiological evidence of bone cupping, but in other sites the lesion may be a myoma (if single, arising from cells in the walls of the blood vessels; if multiple, from the arrectores pilorum muscles or dartos muscles of scrotum and breast areola) or a cavernous angiectom. Whatever it be, in the words of Wood (1812), "the disease luckily admits of a safe and simple remedy, namely, extirpation by the knife." But this extirpation must be complete and wide, otherwise recurrence will take place, although perhaps not for years. In the first case of this series, the primary excision was done at the age of 5, the first recurrence took place at the age of 14, and the next at 16. In the second case, recurrences took place three years and five years after removal.





FIG. IVa. A low power appearance of a glomus tumour showing the dense overgrowth of typical glomus cells around small vessels with myxomatous degeneration in the stroma. (x 100)



FIG. IVb. High power appearance of portion of the same tumour, showing more clearly the classical polyhedral or cuboidal glomus cells. (x 200)

#### *Neurogenic sarcoma.*

Occurring as solitary tumours, 7 were primary and 2 secondary. One of the latter, in the neck, may have been a metastasis from a neuroma of the external popliteal nerve removed elsewhere ten years previously; the other was a very acute spindle-celled sarcoma of the abdominal wall, already mentioned, which arose from one of many neuro-fibromata which had been present for many years.

Of the 9 tumours recorded, 2 arose from the vagus nerve in the neck and 3 others from

unnamed nerve tissue in the neck. The remainder occurred in the cheek, axilla (ulnar nerve), arm and thigh (sciatic nerve). Despite their quasi-innocent appearance as well-encapsulated hard and homogeneous tumours (Figs. V and VI) they were all highly malignant and usually resulted in pulmonary metastases within a year or so. One rather unusual case, however, with proven neuro-sarcoma of the vagus, was still alive, despite local recurrences in glands, and much "root pains," four years after the first operation.

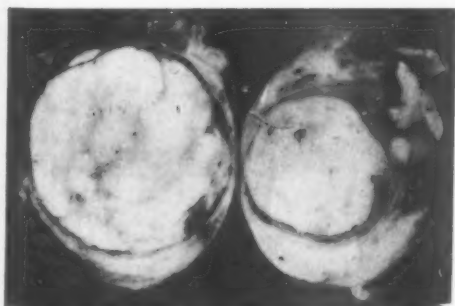


FIG. V. A neurogenic sarcoma of the sciatic nerve with a well developed "capsule" and a homogeneous cut surface.

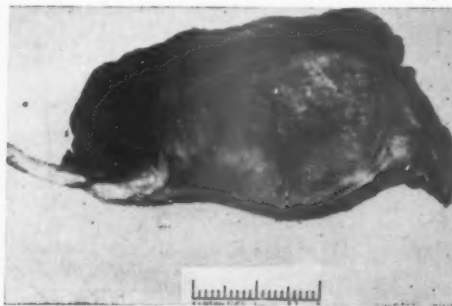


FIG. VI. A neurogenic sarcoma of the median nerve showing its spindle shape, its lack of infiltration and the definite "capsule".

*Neurogenic fibro-sarcomata.*

The 6 tumours in this category were primary solitary tumours, 2 being regarded as "Paget's desmoid tumour" because they appeared in the anterior abdominal wall (Fig. VII). Both recurred on numerous occasions as multiple nodules in the scar of the previous operation and elsewhere in the abdominal wall, necessitating further excisions, X-ray therapy and skin-grafting. One patient was re-admitted six times in five years.

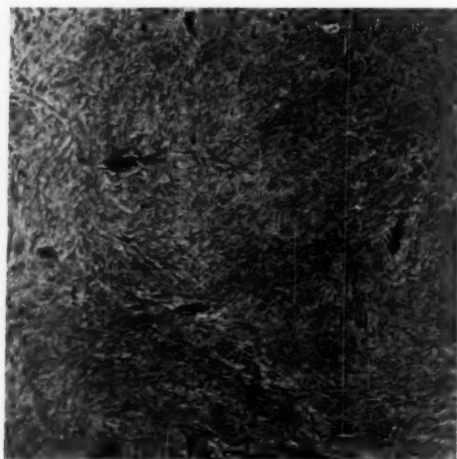


FIG. VII. A recurring type of neuro-fibro-sarcoma of the abdominal wall (desmoid tumour) showing dense palisading and a tendency to form whorls. (x 100)

The other cases occurred in the sciatic nerve in two instances, in the ulnar nerve (in the axilla) and in the clavicle. They were all highly malignant although less so than the neurogenic sarcomata; all died within three years from pulmonary metastases.

*Malignant Schwannoma.*

The only 2 cases occurred in the sheath of the sciatic and posterior tibial nerves respectively, were of a relatively low grade of malignancy and no re-admissions were recorded (Fig. VIII).

*Myxo-neuro-sarcoma.*

These were rather ill defined. One was in the shoulder region and contained structures "related to nerve elements" and the other was in the leg.

There is also another painful skin tumour, no example of which was found in this series, which is a fibrous granuloma arising at the site of an earlier traumatic implantation of silica, after a fall on gravel, etc., or the more common variety arising in a scar in the abdominal wall from the talc from the surgeon's glove. The pain of this lesion is often sufficient to demand excision of the scar, and it is a wise precaution to omit the use of talc in these operations.

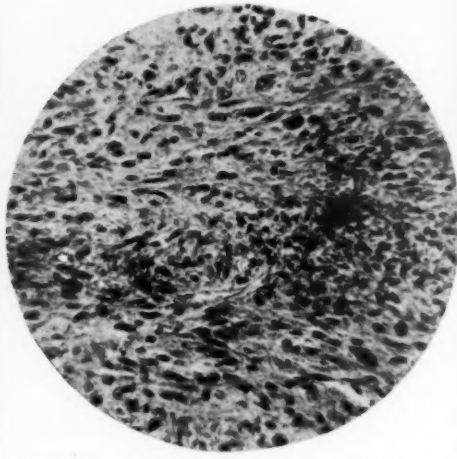


FIG. VIII. A malignant Schwannoma showing irregular proliferation of hyperchromatic spindle cells, but with some attempt at palisading.

#### MICROSCOPICAL APPEARANCES AND HISTOGENESIS.

The general microscopical appearances of malignant tumours varied a great deal and have already been excellently described by Dew (1935). They are divided into three grades of malignancy according to the presence of "Schwann" cells of nerve sheaths in the Schwannomata, "whorls" and fibres in the fibro-sarcomata, and active growth of hyperchromatic spindle cells and giant cells in the most malignant types (Fig. IX).

The histogenesis of the cells of the nerve tumours is still a debatable point. There is the school led by Penfield, Mallory and others who believe that they are all derived from the supporting endoneural connective tissue, and thus have a mesodermal origin, whether benign or malignant. On the other hand, Masson (1924) and others believe

that some, if not all, of the sheath tumours are derived from the Schwann cells, which are migrants from the neural crest and thus ectodermal in origin. Masson also regards the melanomata as neurogenic tumours of the skin.

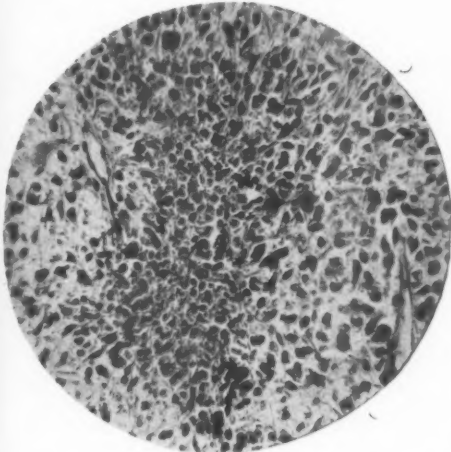


FIG. IX. An active type of neurogenic sarcoma with hyperchromatic spindle cells and giant cells, and no palisading.

#### TREATMENT OF MALIGNANT TUMOURS.

Tempting as it may seem, owing to the presence of a pseudo-capsule, local removal of these tumours is never worth while, and the nerve fibres of the affected nerve must be sacrificed. Recurrences rapidly followed local removal in this series, usually in more highly cellular and malignant forms. In some cases recurrence does not arise from cells of the original growth left behind at operation and the neoplasm is actually or potentially multicentric. Often recurrence was metastatic in the neck or lungs.

The affected nerve trunk must be fully exposed for some distance above and below the tumour and no attempt made to save the nerve or its fibres. With the more malignant grades, amputation should be advised at once if the lesion is in a limb. With recurrences, no matter how small, amputation offers the only hope.

Biopsy, even with an endothermy loop, is dangerous, as it opens the "capsule" and may disseminate cells.

Many of the innocent tumours are best left alone if not causing pain or other symptoms, as operative trauma may induce sarcomatous changes, perhaps in other similar tumours at a distance, and make local recurrences likely.

All the tumours in this series were radio-resistant in contra-distinction to other cellular tumours of a similar appearance arising from non-nervous elements; deep X-ray therapy either as a therapeutic or prophylactic measure did not result in any obvious benefit and had practically no effect on recurrences, though it did assist in getting rid of keloids when given in small repeated doses.

#### ACKNOWLEDGEMENTS.

Acknowledgements are gratefully made to: Professor Harold Dew, Bosch Professor of Surgery in the University of Sydney, for general criticism, and for permission to reproduce Figs. V, VI, VIII and IX from his article entitled "Sarcoma of Peripheral Nerves"; to Dr. Geoffrey Davies, Pathologist to the Royal Prince Alfred Hospital, for his help in selecting the microscopical slides used in Figs. I, II, III, IV and VII, and for histological reports; to the Department of Medical Artistry in the University of Sydney, for the preparation of the photomicrographs; and to Miss D. Kelly, the officer-in-charge of the Department of Medical Records in the Royal Prince Alfred Hospital, Sydney, for assistance in the preparation of the statistics and in searching records.

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## EXPERIENCES WITH THE COMPOSITE OPERATION.

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**G**ENITAL prolapse is common. The diversity of opinion which exists regarding procedure is an indication that the present surgical methods are not entirely satisfactory.

Spalding (1919) stressed the anatomy of prolapse and described a technique which is little different from, and embodies the principles of, an operation which was described by Richardson (1937). As Richardson has done so much to make it popular, and because he makes no claim to originality, but freely acknowledges the work of Spalding, it could, with fairness, be called the Spalding-Richardson operation.

Because he was not satisfied with the results obtained by the routine procedures, Richardson developed his technique by combining the most desirable features of all methods in one operation and called it the "composite operation." The objects of the composite operation are:—

1. Removal of the hypertrophied, lacerated and often diseased portion of the cervix. This is done as a routine in vaginal hysterectomy and is one of the features of the Manchester operation.
2. Removal of the fundus of the uterus at a suitable level. This may be combined with destruction of the epithelium of the cervical canal. This, too, is a routine procedure in vaginal hysterectomy.
3. Preservation of the hub or centre-pin of pelvic support (which is the upper portion of the cervix), because into this the fascial attachments, known to be of value in the treatment of prolapse, can be sutured with the sure knowledge that it has adequate blood supply and will not slough. This is considered to be an essential step in the Manchester repair and some advocates of vaginal hysterectomy make a keel to support the pelvic viscera after the uterus has been removed. This keel often sloughs and, in the rapid clamp method of vaginal hysterectomy, the resultant slough and the infection thus produced

are relied upon to unite the pedicles sufficiently to prevent the formation of vaginal hernia.

4. Approximation of the utero-sacral ligaments thereby reducing the possibility of formation of a hernia of the pouch of Douglas. This manoeuvre is essential in vaginal hysterectomy and some use it during the Manchester operation by deliberately opening the posterior *cul-de-sac*, and approximating the ligaments.
5. Removal of ovaries and tubes if necessary. This is not part of the Manchester technique.
6. Repair of the cystocoele by approximating the pubo-cervical fascia in the mid-line.
7. Preservation of the depth of the vagina. This is desirable in young women and is sometimes difficult to accomplish in vaginal hysterectomy.
8. Approximation of, and advancement in the mid-line of, the transverse cervical ligaments as in the Manchester technique.
9. Repair of the perineum. This is essential in all methods.

### OPERATIVE TECHNIQUE.

The patient is placed in the lithotomy position, and the bladder is emptied by catheter. Vaginal curtains are sewn to the labia and a speculum is inserted in the vagina.

#### *Step 1. Control of the uterus.*

The cervix is exposed, grasped with a tenaculum and drawn towards the outlet. The tenaculum is replaced by guy sutures inserted in each lip. A uterine sound is inserted, the cervix dilated, and the uterus curetted. Dilatation allows sufficient room for the reconstruction of the cervix, and curettage is essential lest any unsuspected disease (which would necessitate total hysterectomy) should be overlooked.

The guy ropes are now tied together, closing the cervix temporarily, and the ends are held in an artery forceps.

*Step 2. Posterior flap of cervix.*

Traction is made on the cervix and tissue forceps are placed laterally in such a manner that when the cervix is amputated, they will be attached to what will constitute the newly-constructed anterior lip. The vaginal mucous membrane is incised and, with the cervix held forward, the incision carried around behind the cervix in a curved manner and deepened so as to fashion a posterior flap. If the pouch of Douglas should inadvertently be opened, it should be at once closed.

*Step 3. Incision and separation of anterior flap. Mobilization of the base of the bladder.*

The cervix is drawn downwards and the anterior vaginal wall placed on the stretch. A tissue forceps placed under the urethral orifice serves as a marker, and with the lateral forceps delineates a triangle which is now stripped of its mucous membrane from above downwards by means of a scalpel until a cellular space between the pubo-cervical fascia and the bladder is entered, after which the flap may be stripped down rapidly by gauze dissection. Special care must be taken in the corners to see that the bladder is pushed well up, thereby taking the ureters out of danger. Any spurting vessels at this stage should be clipped and tied. It is wise to push the bladder up sufficiently to expose the anterior utero-vesical fold of peritoneum. Care must be taken to enter the correct plane and the fold of peritoneum is recognized by its sharp, free, crescentic edge. If this cannot be done, the composite operation may have to be abandoned. At this stage it is desirable to dissect free, and expose, the pubo-cervical fascia, thereby mobilizing the bladder.

*Step 4. Division of the transverse cervical ligaments.*

With traction on the guy ropes the transverse cervical ligaments are exposed and clamped with heavy forceps, divided and ligated with No. 2 chromic catgut. The descending cervical branch of the uterine artery is included in the ligation.

*Step 5. Amputation of the cervix and its reconstruction.*

The desired amount of cervix is removed. The stump is grasped with forceps inserted in the anterior lip. The endometrium may be completely removed from the cervical

segment by coning. A Sturmdorff inverting suture is inserted in the posterior flap and, with two lateral sutures, helps to form the new cervix.

*Step 6. Opening the anterior cul-de-sac and delivery of the uterus.*

The peritoneum is open transversely and the uterus is delivered anteriorly, aided by traction with forceps on its anterior wall. The ovaries and tubes are inspected. If an ovary needs to be removed, the infundibulopelvic ligament is doubly ligated and divided; otherwise the round ligament, tubes and ovarian ligament are divided close to the uterus and the pedicle transected and doubly ligated. The uterine artery is clamped, ligated and divided at the level of the junction of cervix and body.

*Step 7. Amputation of the uterus.*

This may be done with a scalpel at any desired level. The tendency is to remove too much. It is preferable to make the incision wedge-shaped so that the two flaps come together better when closed with mattress sutures. If desired, the endometrium can be removed from the upper end of the stump. The stump is drawn downwards with the help of a retractor and a pack placed in the peritoneal cavity; the utero-sacral ligaments can thus be exposed and sutured together with No. 2 chromic catgut in the middle line as far backwards as desirable. The round ligaments, tubes and ovarian ligaments are then sutured to the lateral angles of the stump.

*Step 8. Closure of the peritoneum.*

The cervix is pulled well forward and the peritoneum is sutured to the posterior wall of the cervix below the closed stump so that the pedicles and the cervix remain extra-peritoneal, and should any bleeding occur, it will be readily observed.

*Step 9. Insertion of the crown suture.*

The transverse cervical ligament on the left side is picked up and the suture carried through the remaining portion of the cervix as high as possible; the right transverse cervical ligament is then picked up. When this suture is tightened, the cervical ligaments are both shortened and advanced, the cervical stump is pulled forwards and upwards and the essential suture in the Manchester technique is incorporated.



*Step 10. Closure of the pubo-cervical fascia.*

This is sutured as a separate layer close to the urethra. A swing suture is then inserted under the urethra into the fascia over the pubic bone in such a manner that when it is tightened, the urethra is elevated, kinked and compressed. This is an essential step if stress incontinence is present.

*Step 11. A routine posterior colporrhaphy completes the repair.*

## SELECTION OF CASES.

*1. Prolapse associated with menorrhagia.*

The combination of menorrhagia and some descent is common. Often such cases are treated by total or sub-total hysterectomy, no regard being paid to the prolapse and the associated cystocele and rectocele. The bleeding is cured, but another operation, made more difficult by previous surgery, must be faced by the patient, if not by the same surgeon. It is not easy to cure prolapse when the keystone of the upper pelvic supports has been removed.

When it is desirable to remove the body of the uterus a choice of method is possible and the composite operation is presented as an alternative.

Vaginal hysterectomy is a good operation. Perusal of textbooks will reveal the many techniques employed in this common procedure. If properly performed, vault prolapse should not occur, but it does, despite care. All authors stress the methods employed by them to prevent it. Every manoeuvre thus described has been incorporated in the composite technique.

The Manchester repair combined with sub-total abdominal hysterectomy is not favoured by gynaecologists because of their inherent dislike for a two-way multiple operation which can be satisfactorily avoided by the vaginal approach.

Two-way procedures have the disadvantage that the more shock-producing part of the operation, the abdominal, takes place after a long period of anaesthesia and is badly tolerated, especially if the operating time has been excessive.

Such a technique, however, has a definite place because prolapse does occur, combined with those contra-indications for vaginal hysterectomy listed in all textbooks, among which are adhesions of omentum and in-

testine to the fundus and previous abdominal pelvic operations such as ventro-suspension or fixation. Such cases are unsuitable for vaginal hysterectomy or for composite methods. The two-way procedure may be the method of choice if the fibroid is too large to deliver through the *cul-de-sac*, and is preferred by the author to vaginal hysterectomy if "morcellement" or bifurcation of the uterus is necessary. The easier and safer method must be the better, and it is bad surgery to hold to a planned line of action when each step shows, with increasing certainty, that the operation is becoming more difficult.

Treatment of prolapse and menorrhagia by the Manchester repair and radium is not desirable because there is an interval between treatments, the patient has to face two anaesthetics, and bleeding may recur in the interval. If the disease causing the menorrhagia is well developed, it may be unsuitable for treatment by radium.

*2. Prolapse in young women.*

Prolapse does occur in menstruating women, and treatment should not be deferred until the menopause.

The Manchester type of repair is the standard procedure. Some favour vaginal hysterectomy because it permits recognition of an enterocele, allows approximation of the utero-sacral ligaments and allows inspection of the tubes and ovaries. If, however, there is much prolapse, shortening of the vagina is likely. This is undesirable in young women. Waugh (1947) states that an abdominal operation may be necessary in such cases.

The composite operation embodies these principles, and in addition preserves some of the cervix. There is little likelihood of malignancy developing in the stump, and this possibility would be reduced still further if the cervix were coned out in the manner described by Spalding (1919). In young women the possibility of further pregnancy following a Manchester repair must be considered, unless the continuity of the tubes has been interrupted. Because the body of the uterus has been removed, the composite operation ensures that pregnancy will not take place. This should not be used as an argument for the technique any more than it should be advanced in favour of vaginal hysterectomy.



## LIMITATIONS AND DIFFICULTIES.

## 1. Age.

Because the average operating time is longer than with a simpler Manchester technique, it is not suitable for elderly patients. The average age of my patients was 42 years, the youngest being 33 and the oldest 71.

2. Difficulties of opening the anterior *cul-de-sac*.

Sometimes this is not easy because of previous anterior colporrhaphy with adhesions in the utero-vesical fold. Selection of the correct plane in which the bladder may be pushed up with gauze dissection is not easy. A common error is to go too deeply and the bladder and utero-vesical fold then recede. The problem occurs in vaginal hysterectomy, but is solved more easily because the posterior *cul-de-sac* can be opened and a finger passed around the uterus to the anterior fornix, which, thus defined, can be opened with confidence.

In the composite operation the posterior pouch is not opened, or, if it has been, is already closed and the posterior lip of the cervix reconstructed. If this is not done early, difficulty may be experienced delivering the uterus because of a hypertrophic and elongated cervix.

## 3. Difficulties of delivering the fundus.

A large uterus is difficult to deliver through the anterior *cul-de-sac*. If "morcellement" or splitting of the uterus, as described by Te Linde (1947) becomes necessary, another method of operation would be easier.

Retroversion likewise is a difficulty, particularly if there is a fibroid tumour in the posterior wall; on one occasion the composite operation was abandoned for this reason. Should the retroversion be truly fixed as a result of pelvic inflammation, the composite operation and vaginal hysterectomy are both contra-indicated. The fact that any previous operation has been done in the pelvis should make one cautious.

## 4. Difficulties with ureters and blood vessels.

The ureters are out of the way if the bladder is pushed up and the pillars clearly defined, especially in the corners, before any attempt is made to deliver the fundus through the *cul-de-sac*. Also it is essential, during the separation of the broad ligaments and

the ligation of the uterine arteries, to keep as close as possible to the uterus.

Difficulty may be experienced with retraction of the infundibulo-pelvic ligament or the pedicle containing the blood vessels at the top of the broad ligament. Double tying is desirable. Similar difficulty is met with in vaginal hysterectomy and on one occasion the author had to open the abdomen to ligate the bleeding vessel. Once, following the composite operation, the ligature slipped after the patient had been returned to bed. Intraperitoneal haemorrhage developed. The abdomen was re-opened 24 hours later, the right ovarian vessels re-ligated, peritoneal toilet performed and restorative treatment adopted. An opportunity was thus afforded to see the reconstructed pelvic floor and the restoration of its peritoneum compared more than favourably with that seen following a total hysterectomy by the abdominal route.

## RESULTS.

456 patients presented for surgical treatment of genital prolapse during the last two years, of whom 58 had, in addition, menorrhagia. These were treated by:—

Manchester operation with abdominal subtotal hysterectomy . . . .	21
Vaginal hysterectomy . . . . .	13
Composite operation . . . . .	24

All patients treated by the composite operation were married and had had more than one child, the average number of children being four. The composite operation is preferable in young women because the length of the vagina is maintained and the tendency to vault prolapse is minimal. No recurrence is recorded. The patients were satisfied, the prolapse being cured in every case. One patient did not have complete relief from stress incontinence, another had a mild recurrence of the rectocele, whilst a third was annoyed by bleeding from the cervical endometrium until this was destroyed by cauterization. The functional result was good; speculum examination of the vagina demonstrated adequate depth and calibre and none complained of dyspareunia. The importance of a high haemoglobin level, good kidney function and freedom from urinary infection is stressed. Multiple operative procedures increase complications, and this operation is no exception. Young people are better able to stand the procedure than the elderly.

The average operating time was seventy minutes, and, although in 18 cases the pulse was below 100 per minute on return to bed, 6 needed blood transfusions during convalescence. The average morbidity was four days, and the longest eighteen days, because of pelvic cellulitis.

Cystitis occurred in 5 cases. An indwelling catheter may not be ideal, but it is preferable to repeated catheterization, which is the alternative. Spontaneous urination in the first five days is not usual.

Gross abdominal distension developed in 2 cases; both recovered following routine treatment.

One patient, previously mentioned, developed intra-peritoneal haemorrhage and was taken back to the theatre for re-ligation of the bleeding vessel.

The average stay in hospital was twenty days and the longest fifty-six days.

There were no deaths.

#### SUMMARY.

1. The technique of the composite operation is described.
2. Its indications and limitations are considered.
3. The results of 24 cases are reviewed.

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## SUPPLEMENTARY COMMENTS ON SPLINTS FOR NERVE INJURIES.

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### AN IMPROVED ULNAR NERVE SPLINT.

ALTHOUGH the principle of support for paralysed muscles in cases of nerve injury is universally accepted, no completely satisfactory splint applying this to ulnar nerve lesions has, as yet, been devised. Such a splint should relax the interosseous and lumbrical muscles by holding the metacarpophalangeal joints in flexion, preferably by spring pressure or elastic traction, permitting movements of unparalysed muscles. One previously described by the writer (1947) is effective in use, but troublesome to make, and cumbersome to wear. The "knuckle-

duster" splints of Hendry and of Highet as illustrated by Seddon (1949) are evidently better. It is suggested that the splint illustrated herewith is an improvement on these two models. It can easily be made for each individual case, and causes the minimum of encumbrance to the patient wearing it.

The splint is made of three parts. Firstly, a cuff of plaster of Paris is bound around the hand, gripping somewhat firmly about the level of the necks of the metacarpals, so that when dry, it requires a little tugging to get it off and a little pushing to get it on again (like a tight kid glove). The hand may be greased first with vaseline, and then powdered with talcum. A piece of spring steel wire (12 gauge) is incorporated in the plaster and bound on with a few extra turns of plaster bandage. As the illustrations show, the wire forms a spring loop on each side with the end bent parallel to the knuckles of the clenched fist. The two ends are threaded into the axis of a roller of a plastic material ( $\frac{3}{8}$  inch polystyrene rod) which rests across the proximal phalanges holding them in flexion. Extension against the spring loops, and full flexion to make a fist are unimpeded, thus providing for active use of unparalysed muscles. If one has spring wires and rollers of different sizes prepared for use, the whole splint can be made in approximately ten minutes.

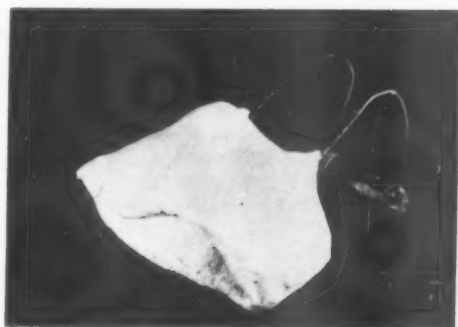


FIG. I. The ulnar nerve splint comprising a plaster of Paris cuff, incorporating wire loops which carry a "roller" of plastic material.

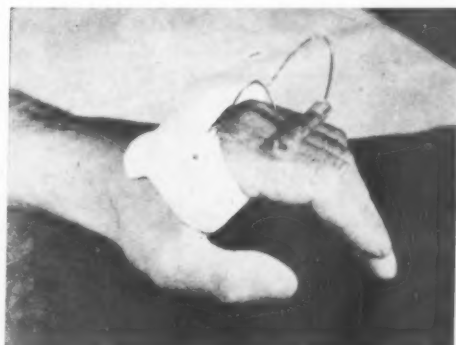


FIG. II. The hand at rest, with splint in position.



FIG. III. The fingers extended against the roller and the resistance of the spring loops.

The illustrations show a case of complete ulnar nerve paralysis first seen some six months after reduction of a dislocated elbow. The patient was a telephone linesman. Transposition of the nerve was required, and thereafter the patient wore this splint regularly for several months pending full recovery, without finding it a nuisance.

A middle-aged woman, after severance of the ulnar nerve of the right hand by a broken window, was fitted with such a splint after healing of the wound. From the beginning her hand was more useful with the splint on and her handwriting was better than without it. She needed no encouragement to wear it during recovery.



FIG. IV. There is no impediment to making a fist.

A schoolboy from the country (where physiotherapy was not available) wore this splint at work and play without being much hindered in his activity. In each of these patients there was a good recovery of the ulnar nerve musculature.

The splint has appeared to be of value each time it has been used, but as only six opportunities have occurred so far, no more extensive claims can be made. It does not cope with the adductor pollicis, and, as with all such splints, represents a compromise between the theoretical ideal and what is feasible. I hope others may be persuaded to try what appears to me to be the simplest form of ulnar nerve splint so far devised. I am much indebted to my friend and neighbour, Mr. Dudley Dalton, who designed this



FIG. V. Type of splint for injury of the median nerve at the wrist.

splint on my suggestions and supplied the spring wire, and the plastic roller as his own interpretation of it.

#### THE ADVANTAGES OF SPLINTING MEDIAN NERVE INJURIES.

During the last year I have had a case of bilateral median nerve injury at the wrists (together with severance of most of the flexor tendons). After the tendons had united, a splint was fitted on the right side, comprising a cuff around the wrist and a padded aluminium support holding the thumb in opposition. It was suggested to the patient, who was a highly intelligent and rather cynical person, that she might wear this at night "to see if it was of any use." After a week she found that the right thumb was definitely stronger in the morning than the left, and on her own initiative she procured a similar article for the other side. This simple example is quoted as illustrating the value of splints in such nerve injuries. One does not often have such an opportunity of using a fair control in assessing the value of these devices (Fig. V).



FIG. VI. The correct type of splint for radial nerve injury.

#### CORRECT SPLINTING FOR INJURY TO THE RADIAL NERVE.

Critics have stated that the advantages of an elastic-traction splint, even in such an obvious case as wrist-drop from radial nerve injury, are merely theoretical, and claim recoveries with as little delay, using a cock-up splint or plaster of Paris slab on the volar surface of the hand, wrist and forearm. It should be sufficient to remind them that a patient with wrist-drop supported by elastic-traction from the dorsal aspect (as illustrated in Fig. VI) has virtually full use of the hand and fingers forthwith; at least, he can drive a car, roll a cigarette, use his dinner knife, and write a cheque, to name only a

few useful accomplishments which cannot be done effectively when a cock-up splint of plaster is bandaged in place.

A medical student who developed right wrist-drop from nerve pressure during the operation of left lower pulmonary lobectomy was referred to me with a cock-up splint in place. He had no doubt whatever of the advantages of the elastic-traction splint which was fitted instead, quite apart from any acceleration of recovery which it may have produced.

#### SUMMARY.

1. A new design of ulnar nerve splint is described and illustrated.
2. A case of bilateral median nerve injury is quoted as an illustration of the value of splinting for this nerve injury.
3. The advantage of an elastic-traction splint for radial nerve injury is reiterated.

#### ACKNOWLEDGMENT.

The illustrations are from photographs by Mr. T. O'Connor of the Clinical Photography Department, Alfred Hospital, Melbourne.

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## CASE REPORTS.

### PROLAPSE OF GASTRIC MUCOUS MEMBRANE.

By T. H. ACKLAND, D. R. LESLIE, and BARBARA G. WOOD.

Melbourne.

#### HISTORICAL.

**P**ROLAPSE of a fold of gastric mucous membrane through the pylorus was first described by Von Schmieden (1911). Eliason, Pendergrass and Wright (1926) wrote an account of the radiological appearances of this condition, and showed that the prolapse could occur in the absence of any other local abnormality such as a polyp or adenoma.

A review of the literature shows that approximately 200 cases have been recorded, most of which have been recognised in recent years. Credit for renewed interest in the study of this problem must be given to Scott (1946), who, after reviewing a series of admissions to a large United States Naval Hospital for the years 1943-4, emphasised that prolapse of gastric mucosa was a clinical entity, and the cause of otherwise unexplained dyspeptic symptoms.

#### INCIDENCE.

It is now clear that the condition is by no means uncommon. Scott (1946) reports an incidence of 1.04 per cent. in 1,346 barium meal examinations, compared with 24.1 per cent for duodenal ulcer and 0.96 per cent for gastric ulcer. Cove and Curphey (1949) report an incidence of 3.38 per cent in 650 examinations, while Ferguson (1948) records its presence in 7.2 per cent of 297 examinations. The most common age of these patients is between 30 and 40.

#### ETIOLOGY AND PATHOLOGY.

A loose redundant fold of gastric mucosa hangs in the pyloric antrum. The etiology of the initial hypertrophy is unknown, but the mucosal redundancy, acting as a foreign body, becomes caught in the pylorus and the apex is propelled into the duodenum. In this way it is drawn out and mechanically increased in size. The fold of mucosa may arise from the lesser or greater curvatures of the pyloric antrum, or even a whole cuff of mucosa may prolapse into the duodenum

like a long rosette. The prolapsed fold usually appears, to the naked eye, as normal mucosa, although in one of the two cases here recorded there was obvious congestion and oedema of its apex from partial strangulation in the pylorus.

Since the prolapse is intermittent, the fold may have returned to the stomach at the time of operation. In such cases, however, a loose fold of antral mucosa may be picked up in dissecting forceps and easily pushed through the pyloric sphincter.

Microscopically the adjacent gastric mucous membrane does not usually show changes suggestive of chronic gastritis, which was suggested by Eliason (1926) as the primary cause of this condition. On the other hand, the redundant fold may show some cellular infiltration, or degenerative changes and haemorrhages as a result of recent strangulation.

#### SYMPTOMS AND SIGNS.

Since the clinical picture is not clear, the diagnosis will usually be made from the findings at X-ray examination after other gastro-intestinal lesions have been excluded. Nor indeed is the mechanism of the production of symptoms well understood. Pylorospasm, blockage of the pylorus, traction on the base of the fold, and partial strangulation of the prolapsed mucosa may all occur at different times, and each plays its part in producing symptoms. Intermittent pain with no regular relation to meals is the most common complaint. It may be merely a vague sensation of epigastric distress, or be severe and cramp-like. Other symptoms are heartburn, flatulence and a feeling of fullness, or nausea and vomiting. Occasionally the apex of the fold may bleed, producing haematemesis or melaena.

Mid-line epigastric tenderness may be found, and Cove and Curphey (1949) describe two cases in which a mass was palpable, and which, when pressed upon,

disappeared to the accompaniment of a gurgling sound, a sensation they compare with the reduction of an inguinal hernia. An important fact of interest to the surgeon at operation is that the prolapsed mucosa cannot usually be palpated through the intact duodenum or pyloric antrum. Consequently, if the clinical features and radiological evidence have together been sufficient to justify exploration, the stomach must be opened and inspected, whatever is found on palpation.

Since there can be no doubt that in the past many genuine sufferers from prolapsed gastric mucosa have been wrongly labelled "functional", this disorder must now be considered in any patient with an atypical dyspepsia.

#### INVESTIGATIONS.

Test meal findings in these patients are not distinctive. Scott (1946) reports that two thirds of his patients with this condition showed a normal test meal or hypochlorhydria, and one third showed hyperchlorhydria. Achlorhydria was present in one of the cases here recorded.

Gastroscopy seldom shows any abnormality, but in our second case a general increase in rugosity at the pyloric end of the stomach was seen.

The diagnosis of prolapsed gastric mucosa is essentially radiological, although the condition may be suspected from the clinical history. The important finding is a filling defect or negative shadow in the duodenal cap. This defect is mainly in the base of the cap, and tends to be of mushroom or cauliflower shape with a lobulated outline. The defect varies somewhat in size and shape during examination, as the folds move and change position. The filled cap is smooth in outline and of normal shape. The abnormality can be seen during fluoroscopy in both upright and recumbent positions, and is best shown in spot films or serial films of the duodenal cap. In some cases it may not be detected during fluoroscopy, but is well demonstrated in films taken when the cap is partly filled.

The two main conditions which may cause difficulty in differential diagnosis are pedunculated gastric polyps or tumours which have

prolapsed into the duodenum, and hypertrophy of the pyloric muscle. It may be impossible to diagnose prolapsed mucosa from the former, but the hypertrophied pyloric muscle produces a smooth mushroom-shaped defect confined to the extreme base of the cap and constant in size, shape and position. Diagnosis from duodenal ulcer should not cause difficulty, as ulcer does not produce a negative shadow in the cap, but rather irregularity of outline, deformity of shape and an ulcer niche.

#### TREATMENT.

Medical treatment consisting of frequent small feedings of a bland diet will often afford some degree of relief in patients with a small mucosal prolapse, and should be tried first in all such cases. In some patients with severe pain and vomiting, rest in bed will also be required.

Operation is indicated by persistence of symptoms, by haemorrhage, or when the diagnosis from carcinoma is uncertain. Several different operations have been used. Ferguson (1948) points out that relief will be obtained by removing the prolapsing mucosa, by short-circuiting the diseased area, or by enlarging the pylorus so that the loose mucosa may move backwards and forwards without causing obstruction. Partial gastrectomy has been performed on some patients, either because of a suspected malignancy, or to avoid leaving a suture line in the presence of a high degree of acidity.

We believe that the simplest procedure, excision of the redundant fold or folds, should be the operation of choice. In each of the two cases here described this was done, after a longitudinal incision had been made in the pyloric antrum. The resultant deficiency was repaired by a catgut suture which also picked up the underlying muscle coat in order to increase the fixation of mucous membrane (Fig. 1). Pyloroplasty or Rammstedt's operation may be combined with the above manoeuvre if narrowing of the pylorus is present.

#### CASE REPORTS.

##### *Case 1.*

L.L., a married woman, aged 52 years, was admitted on Oct. 5th, 1948, with melaena. Nausea and retching had been present for one week. She had

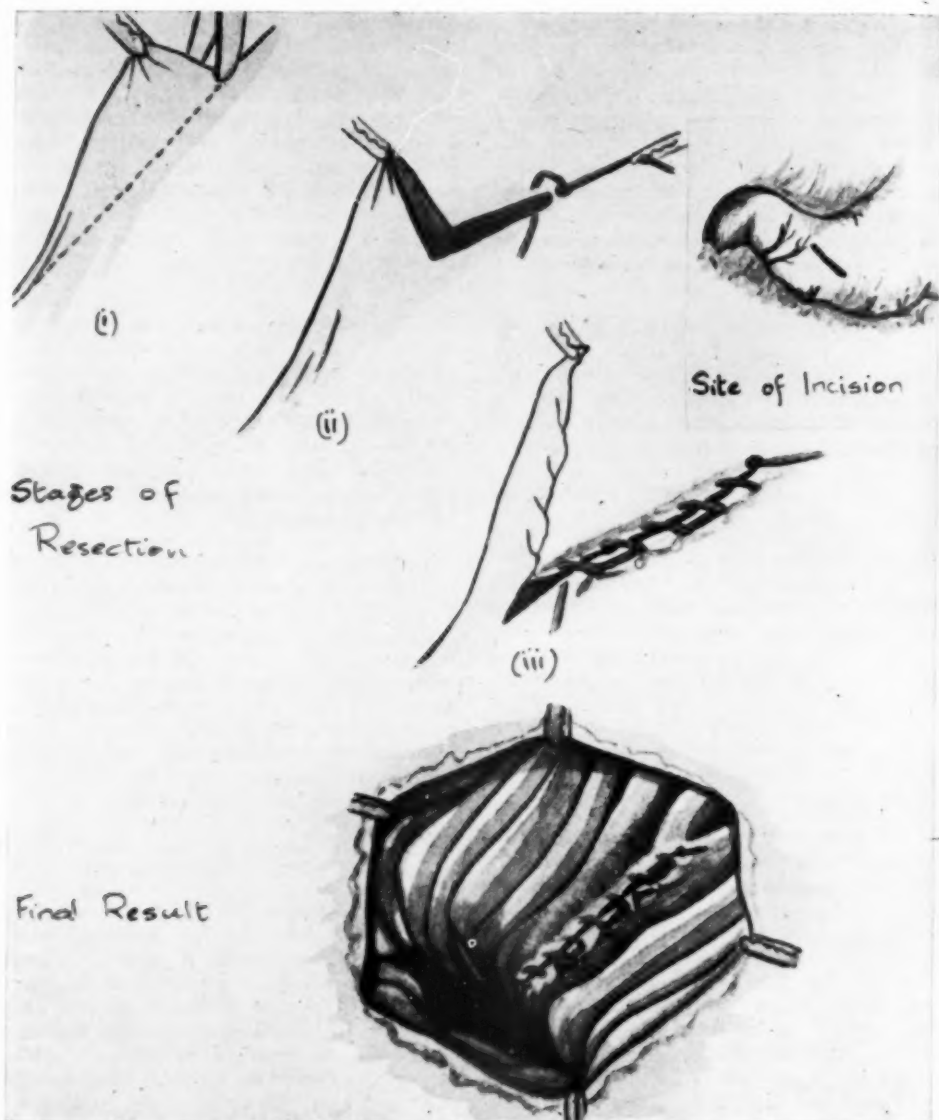


FIG. I. Excision of a redundant fold of mucosa.

fainted one and a half hours before admission and passed a "fair amount" of dark motion.

She had had attacks of diarrhoea for several months two years earlier, but had had no dyspepsia, although her appetite was poor.

In hospital she vomited blood on one occasion and had one melaena stool. Haemoglobin value was 68 per cent on admission, but fell to 55 per cent. Transfusion of two pints of blood was given.

#### Investigation.

Barium meal examination: The duodenal cap was regular in outline, but there was a filling defect in its base, of mushroom shape, with the addition of a smoothly rounded defect nearly three quarters of an inch in diameter, situated towards the lesser curvature. In the pyloric antrum was a straight channel of relative translucency up to one quarter of an inch wide and just over one inch long, leading

from the lesser curvature up to the pylorus. The stomach was otherwise normal (Fig. II). At the time of X-ray examination these appearances were regarded as being due to a gastric polyp with a pedicle attached to a point one inch proximal to the pylorus.

Test meal showed no free hydrochloric acid.

Gastroscopy revealed atrophy of gastric mucosa.

Gastric biopsy showed chronic atrophic gastritis.

Liver function tests showed impairment.

Operation was deferred because of poor liver function. She was re-admitted for operation on Mar. 26th, 1949.



FIG. II. Barium meal finding in case 1.

Operation, Mar. 28th. A conical process of prolapsing gastric mucosa was excised from the pyloric antrum. It was attached by a broad base to the lesser curvature (Fig. III). The apex passed readily into the duodenum and showed degenerative changes.

Microscopic examination of the excised mucosa showed some oedema and accumulation of wandering cells between glands.

#### Case 2.

C.S., a male, aged 43, was seen on Feb. 21st, 1949, with a history of indigestion for many years. Burning epigastric pain, which was not always relieved by alkaline powders, usually occurred after meals. The patient described the pain as being "like heartburn," and "like a lump" beneath the

xiphisternum, and stated that he felt "as if his food sticks there." He also complained of acid regurgitation.

He was admitted to hospital on June 8th, having had severe pain with vomiting during the preceding four days. The abdomen was somewhat distended



FIG. III. Cone of redundant mucosa delivered through incision.

and there was tenderness in the right upper quadrant. A diagnosis of leaking peptic ulcer was considered.

The next day he was much improved, but during the next week there were further attacks of abdominal pain.

#### Investigations.

Barium meal examination: The stomach appeared normal, apart from being of the "cascade" type. Near the base of the duodenal cap a rounded, mobile, filling defect was seen, apparent only in certain stages of filling, but present at three separate examinations. Difficulty was experienced in distinguishing between a polyp and prolapsed gastric mucosa. No definite longitudinal negative shadow was detected in the pyloric antrum (Figs. IVa and IVb).

Gastroscopy revealed no evidence of peptic ulcer, deep peristaltic waves were seen, and more folds of mucosa at the pylorus than normal.

Gastric motility: A recording of gastric motility was made by registering the changes in intragastric pressure by means of a balloon introduced into the stomach and connected with a water manometer attached to a kymograph. Immediately after the introduction of the balloon very active gastric contractions occurred at intervals of 1-3 minutes. These



FIG. IVa. Barium meal findings in case 2.

were more numerous and more active than had been observed in normal controls. This activity subsided after 13 minutes, and over the next hour the degree of gastric motility was within normal limits. Intravenous insulin was given to induce hypoglycaemia, but no active vagal contractions occurred during hypoglycaemia, as may be observed in controls.



FIG. IVb. Barium meal findings in case 2.

Operation, June 24th. A redundant flap of mucous membrane one inch high and two and a half inches long was found on the greater curvature, and could easily be made to prolapse through the pylorus. (Fig. V). It was excised in the manner already described. Convalescence was uneventful.

#### SUMMARY.

1. Two cases of prolapse into the duodenum of redundant gastric mucosa have been described.

2. This condition is not rare, and must be considered in the differential diagnosis of dyspepsia and gastro-intestinal haemorrhage.

#### ACKNOWLEDGEMENT.

We are indebted to Dr. Ian Wood for his assistance in the management of these cases.

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FIG. V. Operative finding in case 2.



## A CASE OF LATERAL DISLOCATION AT THE SUB-TALOID JOINT.

By ROBERT S. LAWSON.

Melbourne.

THE following injury merits a brief record on account of its rarity, and because it throws light on certain points of anatomy concerning the talus and the sub-taloid joint.

### CASE RECORD.

On February 12, 1948, A.B., a male aged 43, fell about 10 feet from a step ladder on to his left foot. The sole of his foot came down on the edge of a step of the ladder which hit the ground first, and a violent eversion of the foot was thus produced. On admission to hospital, there was a gross deformity of the foot and ankle, as shown in the photograph (Fig. I). The prominences of the medial malleolus, talus and os calcis can be clearly recognised with the heel widely adrift to the lateral side. X-ray examination confirmed the presence of a sub-taloid dislocation. There was also a fracture of the lateral malleolus, but the talus remained undisplaced from the mortice of the ankle joint (Fig. II). Five hours after the accident, reduction was undertaken under ether anaesthesia. Despite the most powerful traction and counter-traction with the foot in plantar flexion (to conform with the flexed position of the talus), manipulation was unsuccessful, and after approximately ten minutes, traction was abandoned. While pondering on the next step to be taken, the dislocation incontinently reduced itself while the foot was being merely supported in two hands; so that the precise mechanism of the reduction eludes us still. Fig. III shows the X-ray appearances through plaster of Paris; in the antero-posterior view a small fragment fractured from the infero-lateral margin of the talus is also revealed.

After reduction the patient had a troublesome neuralgia of the toes for many weeks, evidently from excessive stretching of the plantar nerves on the medial side of the ankle-joint. An area of skin three quarters of an inch in diameter, which had been stretched over the medial malleolus, became gangrenous.

Subsequently a complete plaster with a walking iron was applied and maintained for three months. Successive X-ray films taken thereafter revealed the expected decalcification of the tarsal bones generally, but with an increased relative density of the talus itself which reached a maximum some five months after the accident, and suggested the onset of avascular necrosis (Fig. IVa).

However, appearances then began to improve until, in an X-ray film taken 16 months after the accident, the talus showed a normal density (Fig. IVb) indicating complete revascularization. The patient returned to work six months after the accident, and has now a full functional recovery with a normal range of movement at the ankle-joint, and only slight restriction of movement at the tarsal joints compared with his normal foot.



FIG. I. Photograph of the deformity after the accident. Sub-taloid dislocation.



FIG. II. Lateral X-ray view after the accident. Sub-taloid dislocation.

The appearances in the antero-posterior view are so distorted that they add nothing of value beyond what can be seen in the photograph.

### COMMENT.

Sub-taloid dislocations are discussed and reviewed by Shands (1928) and by Smith (1937). Cases were described by such famous surgeons as Astley Cooper, Nelaton

and Broca, but Smith found only 52 cases of lateral dislocation reported in the literature up to 1937. A further case has been reported recently by Hamilton (1949) of Sydney, and doubtless other cases have occurred and not been reported.

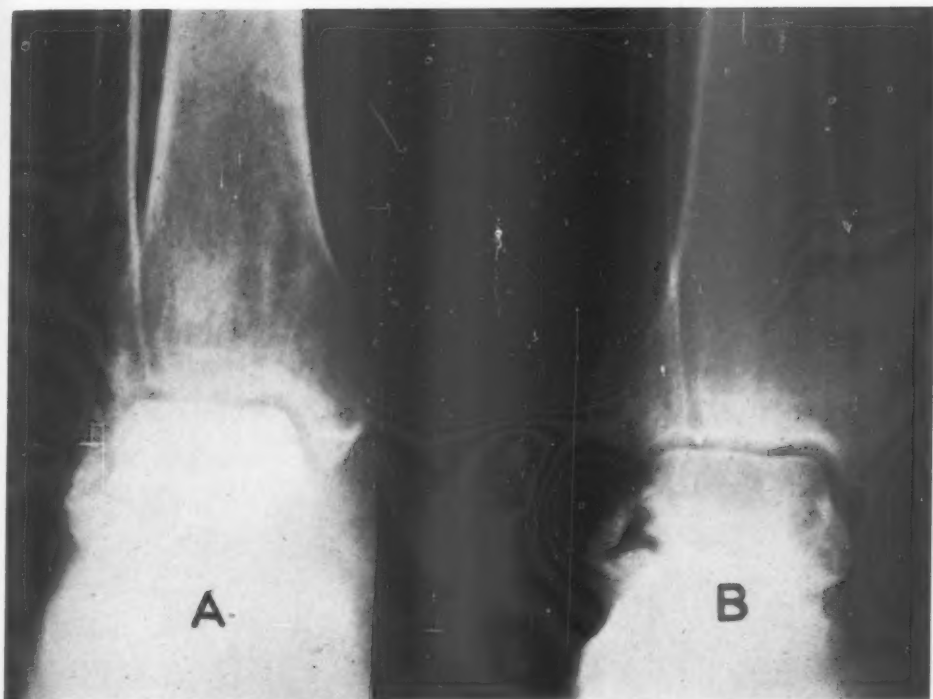
Two points of anatomical interest arise from this case. The first concerns the interosseous talo-calcaneal ligament which is supposed to be the chief bond of union between talus and os calcis. There is an extraordinary diversity in the description of this ligament by different eminent authorities. Berry (1914) describes it as an "exceptionally strong band of short, broad fibres." Grant (1944) states that it is "not very strong." Wood Jones (1944) in his book on "The Foot" declares that this ligament "described habitually in textbooks of anatomy as being of great strength—in many cases hardly merits the name of ligament at all, being but little more than a fibrous septum separating the two joint cavities." This is all the more curious, in that the same distinguished anatomist, as editor of Buchanan's Anatomy (1946), gives his *imprimatur* to

this statement: "The interosseous talo-calcaneal ligament is a discrete and powerful band of union between the two bones."

Obviously this matter requires clarification. Dissections performed in the Anatomy Department of the Melbourne University revealed that both varieties of ligament exist. In some it was indeed little more than a fibrous septum, but in a greater number it was found that when all connections between the talus and os calcis had been severed, including the lateral band described as the frondiform ligament, but with the remaining part of the interosseous ligament intact, the two bones could be wrenched apart only by a most powerful grip, holding the talus in one hand and the os calcis in the other. Or if the ligament were cut with a knife, it was again truly revealed as a "strong band of short, broad fibres." The experience of orthopaedic surgeons in sub-taloid arthrodesis has been similar. They have found that the strength of the ligament varies considerably. It appears also that the stability of the sub-taloid joint must depend a good deal in any



FIG. III. Appearances after reduction of dislocation. Fractures of lateral malleolus and of adjacent lateral surface of talus are revealed in the antero-posterior view.



FIGS. IVa and IVb. Comparable antero-posterior X-ray views taken five months and sixteen months respectively after the accident. At five months the increased density of the talus shows the greatest contrast to the decalcified appearances of the other bones. At sixteen months the talus and the neighbouring bones show the same density and texture. There is extra-articular calcification in the area between the lateral malleolus and the lateral surface of the talus, and relating to the fractures of each of these. This did not appear to interfere with the range of movement of the joints concerned.

case on the calcaneo-tibial and calcaneo-fibular ligaments, which are ordinarily described only as parts of the internal and external lateral ligaments of the ankle joint respectively. These two ligaments binding the os calcis to the malleoli must at the same time hold the talus as a sandwich between them and must also therefore be regarded as important accessory ligaments of the subtaloid joint.

The second point of anatomy raised by this injury concerns the blood supply of the talus, a subject not mentioned in any of the standard works of anatomy. One might assume (as the talus has no muscular attachments) that blood vessels are conveyed to it by means of the capsules of the three joints in which it takes part — i.e., the ankle joint, the posterior talo-calcanean, and anterior talo-calcaneo-navicular, including the interosseous ligament between the latter two. The studies of Sneed (1925) and of McKeever

(1943) suggest, however, that the entire vascular supply of the talus is derived from minute branches of the anterior tibial artery entering the dorsal surface of the neck of the bone in the superior talo-navicular ligament. No blood vessels perforating from the inferior connections of the bone could be demonstrated in injection experiments.

In the case described it is apparent that all inferior and distal attachments of the bone were ruptured. The fact that the talus survived, supports the results of these injection experiments to the extent of suggesting that the great part of the blood supply reaches it in its superior attachments. However, the increased density of the bone, revealed in X-ray films, indicates some loss of blood supply such as might be derived from the torn inferior attachments, despite the fact that no blood vessels could be demonstrated in these ligaments by injection

experiments. In any case, the nutrition of the talus from its main superior vessels of supply suffices pending repair of the talocalcanean ligaments. This is also consistent with the results of sub-taloid arthrodesis, when the bone survives after severance of its inferior connections. The prognosis in cases of sub-taloid dislocation is thus more favourable than might be expected and the remarkable degree of recovery which occurred in the case reported is an example of this.

I am greatly indebted to Dr. Nicholas Hamilton, of the Alfred Hospital, for the photograph of the original deformity in this case, no previous example having been published as far as I am aware. I am also very pleased to acknowledge the help given by Professor S. Sunderland, Professor of Anatomy in the University of Melbourne.

#### SUMMARY.

1. A case of lateral dislocation of the sub-taloid joint is described.

2. The anatomy of the interosseous talocalcanean ligament and of the blood supply of the talus is discussed.

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## REMOVAL OF THE SCAPULA FOR SARCOMA, WITH RETENTION OF THE ARM.

By G. H. BURNELL and JOHN MAYO.

Adelaide.

THE removal of the scapula, with retention of the arm, is by no means a new operation. Indeed, Graham (1949) states that the great James Syme "was one of the first to remove the entire scapula with retention of the arm." However, we have been able to find only one reference to this subject in the recent literature available to us. Ghormley and Flashman (1947) reported the history of a male, aged 43, whose scapula they had removed for osteo-chondroma and who remained well nineteen months afterwards. Our patient, who was found to have a sarcoma, was operated upon in November, 1948, and remains well eleven months after operation, with no detectable evidence of recurrence.

### CASE REPORT.

T.B., male, aged 58, was admitted to the Royal Adelaide Hospital on July 13th, 1948. Nine weeks prior to admission he had begun to experience pain in the region of the left shoulder joint with limitation of movement. Both pain and limitation of movement had gradually increased, but he had not noticed any lump in the painful area. There was no history of trauma.

The only significant points in his previous history were that eight months before he had had a painful right hip joint and that he had recently noticed some difficulty in holding his urine.

Examination disclosed a large, apparently uniform swelling of the left scapula with marked limitation of all movements at the shoulder joint, but with very little limitation of movement of the scapula on the chest wall. Attempts at both active and passive movement at the shoulder joint caused considerable pain. In view of the previous history of pain in the right hip and the recent urinary trouble, the possibility of metastatic deposits from a prostatic carcinoma was considered. A pelvic examination showed some adenomatous enlargement of the prostate gland but nothing to suggest a malignant change. Skiagrams were taken of the pelvis and lumbar spine, the tibiae, the skull and the chest. Those of the pelvis showed the presence of Paget's disease of the amorphous type, but the skull showed none of the changes typical of that disease. X-ray films of the shoulder showed a large area of rarefaction involving the neck of the scapula, portion of the glenoid, the base of the coracoid process and the spine of the scapula with a little apparent coarse trabeculation and sclerosis of bone on the lower aspect extending down the axillary border.

This appearance was suggestive of a giant-celled tumour, but a simple cystic condition could not be excluded, nor could a malignant bone lesion. The appearance, however, was not typical of metastatic deposits (Fig. 1).



FIG. 1. Radiograph of the left shoulder region, showing erosion of the neck of the scapula with sclerosis of the bone extending down the axillary border.

Various laboratory investigations were then carried out, with these results:

Serum acid phosphatase, normal (2.1 King and Armstrong units).

Serum alkaline phosphatase, considerably raised (4.1 units).

Serum calcium, normal (9.1 mg. per cent).

Serum inorganic phosphorus, normal (3.2 mg. per cent).

The Wassermann, Kline and Kahn tests of the blood all gave negative results.

The patient was then referred to the Radiotherapy Clinic for treatment. He was seen by the consultative committee of this body on July 27th. The nature of the condition was then by no means definite and, after considerable discussion, it was decided to suggest to the surgeon that a biopsy be performed to give more adequate information as to the type of tumour, although biopsy of a sarcoma before irradiation has not been as a rule regarded favourably by the committee.



On July 28th, under local anaesthesia, material for a biopsy was taken from the tumour of the scapula. Dr. Orde Poynton reported on this as follows: "The sections show a polymorphous cell sarcoma containing cells with nuclei of greatly differing size and shape. The most common type is a pale oval nucleus, the chromatin of which is inconspicuous. There are also numbers of much larger and more darkly staining nuclei of irregular shape. Some of these are double. Mitoses are frequent and obviously irregular; some giant mitoses are seen. The cell protoplasm is indistinct and the cell outlines seldom visible, the growth appearing syncytial in type. No vessels are seen, but there are occasional blood spaces which are lined by tumour cells. At other points the growth is haemorrhagic. No giant cells suggestive of myeloma are seen." (Fig. II)

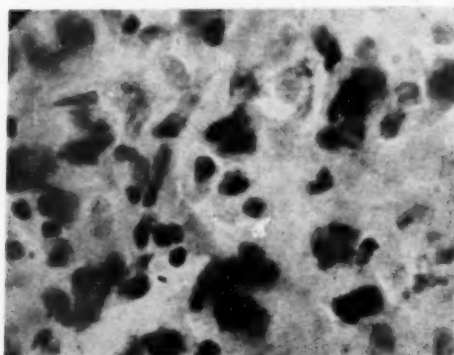


FIG. II. Section of the tissue taken at biopsy, showing the polymorphous character of the tumour.

On receiving this information the committee recommended deep X-ray therapy followed by surgery.

For a number of years the practice of the Radiotherapy Clinic in treatment of sarcomata involving bone has been to use an intensive irradiation of the growth, followed by surgical removal if possible. The reasons for this procedure have been set out in a previous article by Mayo (1948) and will not be repeated here, but as such treatment has been followed by a small but gratifying number of apparent successes, a similar method was adopted in this case.

Using X-rays generated at 225 K.V.P., four tangential fields 10 by 15 cm. were applied to the left scapular region, with, in addition, a postero-anterior field 9 by 9 cm. directly over the mass. Filtration was 0.5 mm. copper plus 1 mm. aluminium; the H.V.L. was 1.3 mm. copper, and the focal skin distance 50 cm. It had been intended to give a central dose of 8000 r in eight weeks, but when a central dose of 6000 r was reached in just over five weeks a very brisk reaction developed with epidermolysis of the whole of the irradiated area. As this area measured 15 by 15 cm., the dosage can justly be described as massive.

After a further five weeks the skin had almost completely healed, the mass had practically dis-

appeared and the patient stated that his shoulder was comfortable. He was then returned to his surgeon, who carried out the surgical procedure narrated below.

Apart from a necrotic ulcer measuring 3 by 2 cm. which developed after the operation, but subsequently healed, no ill-effects due to irradiation were seen.

Following the course of deep therapy, he began to feel really well, was gaining weight, and had very little pain in the shoulder. It was therefore decided that an attempt should be made to remove the scapula. For this purpose he was re-admitted to the ward on November 24th.

On November 25th the operation was undertaken. An incision was begun at the root of the neck on the left side, passing out along the upper border of the scapula, and then diverging to the anterior and posterior axillary folds. Large skin flaps were retracted so that the whole of the posterior surface of the scapula was exposed. The division of the muscles attached to the scapula was then begun at the upper and inner angle, proceeding down the vertebral border, then working up along the axillary border to the glenoid cavity. Next the capsule of the shoulder joint was opened, divided completely close to its attachment to the humerus, the clavicle divided about its middle by means of a Gigli saw, the muscles attached to the coracoid process divided, and the whole of the scapula removed. The bone itself was seen to be heavily eroded.

In order to prevent the unsupported arm dragging on the brachial plexus, a strip of fascia lata was passed around the second rib, after pushing back the parietal pleura, and passed through the short remaining portion of capsule at its site of attachment to the inner side of the neck of the humerus; on pulling on the strip of fascia the head of the humerus was held quite firmly in position; in fact, as the photograph shows, the left shoulder is now slightly higher than normal in position. Whether this manoeuvre was necessary, we do not know, as Ghormley and Flashman (1947) did not record any steps taken to fix the arm, and their patient apparently did not suffer any ill-effects from their omission to do so, but it seemed a reasonable precaution to take.

The patient's post-operative course was uneventful, and he was discharged from hospital on December 15th, 1948. He has been seen frequently since that date, appears to be quite well at the time of writing and frequent skiagrams have shown no sign of pulmonary deposit. As will be seen from the photographs, he has a useful arm, with quite strong flexion at the elbow joint, and is able to do light work (Figs. III, IV and V). However, a further serum alkaline phosphatase test, done on October 13th, 1949, gave a result of 45 King and Armstrong units, suggesting that the condition may be still active. On the other hand, the high reading might equally well be due to the presence of Paget's disease. The latter suggestion is supported by the facts that further X-rays of the chest and long bones again gave negative results, and that the patient's general condition remains excellent.



FIG. III. Photograph of the patient after operation showing the useful range of movement of the arm. It will be noted that the shoulder operated upon is higher than the normal one.



FIG. IV. Posterior aspect of the shoulder photographed shortly after operation, showing the lines of the incision. The redundant skin fold flattened out over the course of a few months.



FIG. V. X-ray of the left shoulder region after removal of the scapula. When the arm is passively abducted the head of the humerus impinges on the cut end of the clavicle, which could have been removed more extensively.

#### DISCUSSION.

The only alternative to excision of the scapula would appear to be a fore-quarter amputation, and it did not seem to us that this would be any more likely to result in a permanent cure than would a removal of the scapula only. Up to the present this policy appears to be justified.

It is of great interest that Dr. Poynton, when examining the scapula after its removal, was unable to find any viable neoplastic cells (Fig. VI). A gland taken from the region of the tumour showed intense sinus catarrh, but there was no evidence of involvement by sarcoma. A further matter of interest is the precise nature of the tumour. There appears to be no doubt that it was a sarcoma of an osteolytic type, but whether it had its genesis in bone or in some adjacent tissue of mesenchymal origin is not so certain. Nevertheless, the presence of Paget's disease is strongly suggestive of the growth arising in bone. Ewing (1942) states that Nancrede could find no cases of recovery from sarcoma of the scapula, but Willis

(1948), in a section dealing with reticulum-cell sarcoma of bone, while making no reference to the scapula, refers in general to the destructive character of this type of growth, its variable but sometimes favourable response to radiation, and the pleomorphic type of cells with reticulum fibres between the cells. Unfortunately, our sections were not specially stained to display such characters.

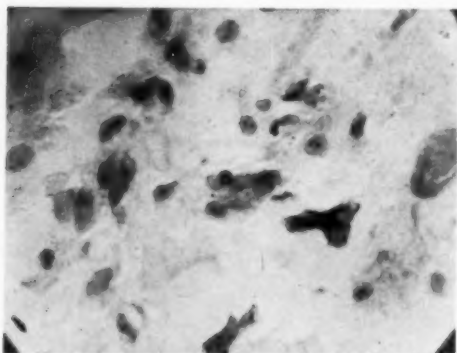


FIG. VI. The most cellular portion of the tumour after radio-therapy.

#### SUMMARY.

A case of polymorphous cell sarcoma of the scapula is recorded. It was treated in the first instance by intensive deep X-ray therapy. Subsequent examination showed, apparently, complete destruction of the tumour cells.

Following irradiation, the scapula was removed; a fascial sling from the second rib to the small remaining portion of the capsule of the shoulder joint on the inner side of the humerus was employed to hold the arm in position.

#### ACKNOWLEDGEMENT.

We are indebted to Mr. S. Krantz for very material help and suggestions prior to, and during the operation.

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## Books Reviewed.

### THE CHILD IN HEALTH AND DISEASE.

By CLIFFORD G. GRULEE, M.D., and R. CANNON ELEY, M.D. Baltimore: The Williams & Wilkins Co., 1948. 10" x 6½", xiii plus 1066 pp., numerous illustrations. Price: 90s.

Drs. Grulee and Eley have produced after considerable delay, largely due to the War, a new textbook on Pediatrics.

They have adopted what is becoming a standard technique in the production of such works in that there is a large series of contributors and an extensive list of references. No less than seventy-five persons contribute articles; in that group there are many unfamiliar names, but one notes with pleasure those of Grover Powers, Irving Wolman, Theodore Ingalls, Mitchell Rubin, Priscilla White, Heyworth Sanford, James Wilson, Sidney Farber, Frederick Tisdall, and others.

It is becoming abundantly clear that it is impossible to cover completely all aspects of a major subject like Pediatrics in any one volume. In the work under review, many conditions are afforded scant time and space; if further detail is required, there are usually references to help. It would be somewhat of a rarity for a senior man to obtain all the information he required from the book alone, though there are some excellent and complete articles, notably one by Priscilla White on juvenile diabetes, by Lee Forrest Hill on tuberculosis, and an interesting and important chapter on accidental poisoning of infants and children by John Aikman.

It is inevitable when major advances are occurring coincidentally with the production of such a massive volume (and this must always be so) that some subjects must be inadequately covered. Congenital heart disease and streptomycin fall into this category.

The book is handsomely mounted, the paper is excellent, the illustrations in general are adequate. It is essentially a text-cum-reference book, and as such it has great value.

### A SURGEON'S GUIDE TO LOCAL ANAESTHESIA.

By C. E. CORLETTE, M.D., Ch.M., F.R.A.C.S. Bristol: John Wright & Sons Ltd., 1948. 8½" x 5½", xi plus 355 pp., 200 illustrations. Price: 42s.

This book is the result of many years of devotion to scientific study of the subject.

The author has culled from his wide experience many surgical procedures which may be carried out under local anaesthesia, or more strictly under narco-local anaesthesia. He has stressed wisely and in no uncertain manner the dangers that will arise from the incorrect use of local anaesthetics, and has shown how these pitfalls may be avoided. Emphasis is laid on the necessity for the gentle handling of tissues.

Some statements may be considered provocative. However, "the words of the wise are as goads," and they were no doubt made to cause the reader furiously to think.

Details of procedures which must be followed to ensure the best results and to reduce shock to a minimum are set out with meticulous care. The needs of the practitioner who has not ready access

to a reference library have not been overlooked, for many excellent anatomical and other diagrams have been included.

It is also noted that local anaesthesia may be of great use to doctors practising single-handed in sparsely populated areas.

The book is a mine of information and is destined to become a classic and a standard book of reference on the subject. It should be read and carefully studied by all who wish to become proficient in the science and art of local anaesthesia.

### MUSCLES—TESTING AND FUNCTION.

By HENRY O. KENDALL and FLORENCE P. KENDALL. Baltimore, U.S.A.: The Williams & Wilkins Co., 1949. 11" x 8½", xi plus 278 pp., 162 figures, numerous charts and tables. Price: 56s. 3d.

Adequate treatment of an important subject and an intelligent presentation invariably evoke the eulogies of the reviewer. This work has these characters to a high degree and is a classic in its particular sphere.

The underlying principles in manual muscle testing and the recording of the findings introduce a detailed consideration of the functions and testing of each particular muscle. This latter investigation is very attractively presented by large, clear photographs, and the detail of testing comprises the legend in the following order: Position of the patient, fixation (to avoid trick movements), testing (counter)-pressure, and the features of weakness and shortening of the muscle. This latter reference is novel and will enhance the clinical value of the book.

All whose interest in orthopaedics (especially infantile paralysis and nerve injury) necessitates their familiarity with muscle function and testing will find this excellent book invaluable.

### FRACTURES AND ORTHOPAEDIC SURGERY FOR NURSES AND MASSEUSES.

By ARTHUR NAYLOR, Ch.M., M.B., M.Sc.(Sheff.), F.R.C.S.Eng., F.R.C.S.(Edin.). Second Edition. Edinburgh: E. & S. Livingstone Ltd., 1948. 8½" x 5½", xiv plus 296 pp., 251 illustrations. Price: 17s. 6d. net.

Mr. Naylor has managed to pack into these 290 pages the whole gamut of the essential principles of orthopaedics, and this book is a short review which should be read not only by nurses and physiotherapists, for whom it is intended, but by the medical student during his early days at the clinical school. Complicated details have been wisely left aside for space given to effective diagrams and illustrations; many of these are familiar friends, and have been excellently chosen for the purposes of simplifying the text.

Particularly impressive are the sections on fractures and congenital deformities; in the former, the author has managed to encompass the whole range of common fractures and cover the treatment of these along most modern lines. In the congenital deformities section he has selected a half-dozen of the more usual conditions, and compiled a very practical chapter on the pathology and treatment of such matters as club foot, for which the Denis Brown regime is unconditionally recommended.

In the excellent section on theatre technique and equipment, the error of naming a Tubby's foot wrench "Thomas's" should be corrected; otherwise this chapter will be invaluable for staff nurses and charge sisters in an orthopedic theatre, containing as it does illustrated information of the armamentarium required for the various operative procedures.

This book is well produced—the material, type and general editing make its reading a pleasure, and it is thoroughly recommended to all who are looking for a concise primer of orthopedic surgery.

#### BAILEY'S TEXT-BOOK OF HISTOLOGY.

Revised by PHILIP E. SMITH, Ph.D., and WILFRED M. COPEHNAVER, Ph.D. Twelfth Edition. Baltimore: The Williams & Wilkins Co., 1948. 9" x 5½", 800 pp., 455 illustrations. Price: 52s. 6d.

This work on histology has always been an excellent textbook for students of medicine and dentistry, and its value is enhanced in this twelfth edition. Moreover, more advanced students of the subject will find food for further reading in the useful bibliography which ends each chapter. This has been well chosen, including as it does such excellent references as the work of Trueta and his Oxford colleagues in 1948 on the renal circulation.

A pleasing feature of the book is the attempt to link Histology with gross Anatomy on the one hand and Physiology on the other. Evidence of this will be found in the chapter on the organisation of the nervous system, and in the repeated references throughout to the relation between structure and function. It has also been rendered more interesting to the student of medicine by the incorporation in the text of many references to the influence of various organs and tissues on disease processes.

The illustrations, which have always been good, have been improved by the addition of a number of new photomicrographs. Even more of these would be welcome to the student of Histology, who would be glad to see in such a textbook an actual photograph of sections of palatine tonsil, vermiform appendix and ureter, or even a piece of typical fibro-cartilage. The integuments are fully covered by photomicrographs; the chapter dealing with the endocrine glands could have been similarly treated with profit to the student.

Particularly good chapters are those on the lymphoid organs (where there are some excellent diagrams) and the female reproductive system.

In short, the book is recommended to the student as covering completely and relatively concisely the subject of human Histology, in an interesting and readable form.

#### PARATHYROID GLANDS AND METABOLIC BONE DISEASE.

By FULLER ALBRIGHT, A.B., M.D., and EDWARD REIFENSTEIN, Jr., A.B., M.D., F.A.C.P. Baltimore: The Williams & Wilkins Co., 1948. 9" x 5½", xxvi plus 393 pp., 157 figures. Price: 60s.

A monograph dealing with generalised bone disease associated with the name of Fuller Albright necessarily will attract immediate attention. All those interested in such conditions, and particularly the ones due to parathyroid disturbance, will be acquainted already with at least some of the numerous papers written by this author in the last twenty years. The present volume deals with much of this work, and it is clear that its authors have a first-hand and extensive knowledge of their subject.

The introductory chapter deals with physiology and pathology of the parathyroid glands. Students will find it particularly valuable. Hypoparathyroidism is then dealt with, and in chapter III there is a very clear and comprehensive account of hyperparathyroidism. The action of Vitamin D and dihydro-tachysterol is then discussed.

Under the metabolic diseases, following a general chapter, there are chapters dealing with osteoporosis, osteomalacia, Albright's disease (Polyostotic fibrous dysplasia) and osteitis deformans.

The presentation of all these subjects is wide, embracing physiological as well as morphological aspects. A working hypothesis regarding mechanism of production is presented in each. Some of these may not be entirely acceptable, but, as the authors state, "the hypotheses . . . are subject to change without notice." There is no question of the high standard of the observations.

In their preface the authors remark "that, by pointing out the shortcomings . . . the wind will be taken out of the sails of those of the reviewers who will be impressed largely by the faults of this work." Such a reviewer would have to be specially captious because the good points preponderate greatly over any faults. One point, however: they say they "are aware of the liberties they have taken with the English language." One would agree with such abbreviations as "Serum calcium." But objections must be taken to such statements as "Parathyroid pathology consists of so and so or is explained by such and such!!" When will we cease to suffer from such gross misuse of the word Pathology? This, of course, is not peculiar to the present volume.

The text is clear and the illustrations are good—well chosen, representative, well reproduced and adequately documented. There is a satisfactory subject index, an author index and a good bibliography. In a literature which is continuously and rapidly growing this is quite satisfactory and will be found to be a good introduction to any advanced study of the subject. Its principal weakness is that it is almost entirely American in scope.

The book is a good one, and it is wholeheartedly recommended to all who are interested in the subjects discussed, whether such interest be primarily biochemical, endocrinological, pathological or clinical.

#### MODERN TRENDS IN DERMATOLOGY.

By R. M. B. MacKENNA, M.A., M.D.(Comb.), F.R.C.P.Lond. (Editor). 1st Series. London, Eng.: Butterworth & Co. (Aust.) Ltd., 1948. 9½" x 6½", xiv plus 432 pp., 32 figures, tables. Price: 55s. 6d.

The Editor, Dr. R. M. B. MacKenna, has succeeded well in his task of selecting his team of contributors and the scope of their chapters in the first series of Modern Trends in Dermatology.

There is a remarkable evenness of quality considering that twenty-three varying authors are responsible for the eighteen chapters.

Of the eight dermatologist authors, three are Americans and the remainder British.

The non-dermatologist authors are largely anatomists and physiologists.

This work is obviously intended for the dermatologist and the graduate studying to be a dermatologist, although many chapters will be found of value to the general medical reader for reference.



Each chapter concludes with an excellent set of references.

Acne exemplifies the difficulties of the Editor in a work of this type.

Dr. Barber in his chapter, "The influence of the Sex Hormones on the Skin and the Pilosebaceous Glands," builds up a case for the role of the androgens as a major causative factor. He quotes cases of adult castrates in whom severe acne is produced when testosterone is exhibited.

Dr. Wittkower in his chapter, "Psychological Aspects of Dermatology," quotes of one of his patients, "At the age of fifteen he started to masturbate, with severe pangs of conscience"; "His acne commenced when he was fifteen years old."

Occupational dermatoses are stated by Dr. Louis Schwartz to be responsible for about two-thirds of the occupational diseases for which compensation is paid in the United States.

His chapter "Occupational Dermatoses" might well be regarded as essential reading for those medical men and barristers who have occasion to appear before courts in litigation involving these conditions. The concluding chapter, "On the use of Statistics," by Mr. Cooper-Willis, is of such importance to medical writers that one hopes that it may be issued in future as a monograph.

Chance checking of the index and the index of authors showed both to be correct.

The book is well bound, clearly printed on good, glossy paper, and the illustrations are excellent and well selected.

#### ILLUSTRATIONS OF SURGICAL TREATMENT

(Instruments and Appliances).

By ERIC L. FARQUHARSON, M.D., F.R.C.S.(Ed.), F.R.C.S.(Eng.) Third Edition. Edinburgh: E. & S. Livingstone Ltd., 1949. 6" x 9½", ii plus 391 pp., 319 figs., 61 plates. Price: 25s.

In this volume Eric Farquharson has endeavoured to describe methods "rarely covered in the textbooks of general surgery." It is evident from the book that the author is capable of describing, with clarity and conviction, the practical essentials required by any student or surgeon who may desire information on any method here mentioned. Printed in clear type and amply illustrated by photographs, it is a pleasure to read.

It is not clear, however, for whom the book is intended. It is almost entirely a practical handbook for the orthopaedic surgeon, and his resident staff, but too detailed for the undergraduate student. Then comes a strange appendix containing illustrations of surgical instruments—General, Orthopaedic, Abdominal, Genito-urinary, Thoracic, and Miscellaneous, intended for the instruction of candidates for surgical examinations. These are all clearly depicted and are a good selection. Nevertheless they seem out of place.

One could not find fault with the methods described for treating the various injuries. They are well tried and widely approved and still show an awareness of modern teaching.

It is strange that the "general surgeon" in his study of the treatment of injuries is allowed to be unaware of the presence of neighbouring soft tissues. The section on the treatment of spinal fractures would have benefited by a consideration of the many

practical difficulties to be encountered in the management of the paralysed patient. Damage to pelvic viscera, as complications of fractures of the pelvic bones, should have received some mention.

Since it is attention to detail which brings success in orthopaedic surgery, it is a pity that some points are mentioned, but elaborated. For example, the importance of preventing infection around traction pins introduced through the tibia is noted, but how successfully and by what methods, is left to the imagination.

While the experienced surgeon would understand the limited field which a small book like this should cover, the examinee might take for granted from reading it that there were no such procedures as the immediate, open fixation of fractures of the long bones or of spinal fusion, to mention only two which come to mind. Further, it would not have been out of place to have mentioned, if only briefly, the general principles involved in the management of compound fractures.

#### PLASTER OF PARIS TECHNIC.

By EDWIN O. GECKELER, M.D. Second Edition. Baltimore: The Williams & Wilkins Co., 1948. 8½" x 5½", xiv plus 220 pp., 236 figures. Price: 22s. 6d. (Aust. currency).

The second edition of this work gives a clear and concise description of the use of plaster of paris in the practice of surgery. Full and complete details are given of material required and the actual making of plaster bandages. There is an excellent chapter devoted to the use and technique of pattern plasters. The actual application of all types of plaster casts to the various joints of the body is fully described.

The book is profusely and excellently illustrated. The result is that the text is easy to read and the technical points can be grasped readily by the aid of the illustrations.

A chapter is also given on the aftercare of plaster cases. This is the weakest part of the book, and it is felt that this could be given in greater detail, and the immediate nursing care of plasters stressed.

The book, however, can be recommended to all who have to use plaster. To the student and resident it will provide the ground work.

The general practitioner will find much of interest.

The orthopaedic surgeon should find points of technique which will improve his plaster work.

#### PRACTICAL METHODS IN BIOCHEMISTRY.

By FREDERICK C. KOCH and MARTIN E. HANKE. Fifth Edition. Baltimore: The Williams & Wilkins Co., 1948. 9" x 5½", ix plus 419 pp., 51 tables, 22 figures. Price: 22s. 6d.

Practical Methods in Biochemistry, by Koch and Hanke, has now reached its fifth edition. The book is divided into three main sections. Part I, *The chemistry of cell constituents*, contains details of simple tests for carbohydrates, lipins, proteins and amino acids, nucleoproteins and nucleic acids, and a chapter on hydrogen ion activity and pH. Part II, *The chemistry of the digestive tract*, gives simple tests on salivary, gastric and intestinal digestion and a chapter devoted to constituents of bile. Part III, *Blood and urine*, devotes much space to consideration of haemoglobin and its derivatives, and this is followed by quantitative analysis of blood and of urine and chemical examination of urine for pathological conditions.

In the preface to the first edition the authors state that no attempt has been made to interpret the significance of the results of blood and urine analysis. In the opinion of the reviewer, the book would be of much greater value—particularly to medical students—if a short note on the significance of the tests were included, and it would make the performance of the practical work of more interest. An examination of artificially prepared normal and pathological samples of cerebrospinal fluid prepared in a somewhat similar manner to that described for pathological urine might be included with advantage in a future edition.

The book contains very useful chapters on colorimetric and fluorometric methods of estimating vitamins, certain microbiological methods, and concludes with chemical tests for hormones.

The volume is a valuable contribution to the subject of biochemistry.

#### BRONCHIOGENIC CARCINOMA AND ADENOMA.

With a Chapter on Mediastinal Tumours.

By B. M. FRIED, M.D. Baltimore: The Williams & Wilkins Co., 1948. 9" x 5½", xiv plus 306 pp., 118 figures. Price: 45s. 6d. (Aust. currency).

This monograph "is the outcome of extensive studies based on large clinical and post-mortem material," and describes bronchogenic carcinoma and bronchial adenoma in detail. No aspect is omitted. The discussion of the recent apparent increase in the incidence of these diseases, and of present knowledge concerning their etiology and their pathology is very full and clear, and should be of considerable value.

The descriptions of the clinical pictures are, however, not very vivid, partly because individual signs and symptoms are considered seriatim without much attention to their relative importance. A whole chapter is devoted to hypertrophic pulmonary osteoarthropathy. In the description of methods of diagnosis the effort to include every possible method, important or otherwise, has resulted in the same lack of balance. Bronchoscopy receives less than one page. Published results of treatment of bronchogenic carcinoma by surgery and by radiotherapy are well reviewed. A description of technical details of treatment by surgery or radiotherapy is not included.

Some innocent tumours of the lung are mentioned, but adenochondroma (hamartoma) is omitted. The chapter on tumours of the mediastinum is too brief to be more than very sketchy.

The illustrations are well chosen and, apart from some of the reproductions of radiographs, very clear. Very full lists of references are given at the end of each chapter.

This book contains a mine of useful information on the subject. The clinical aspects are not so well presented as the pathological.

#### EXPERIMENTAL SURGERY, INCLUDING SURGICAL PHYSIOLOGY.

By J. MARKOWITZ, M.B.E., M.B.(Tor.), Ph.D., M.S. in Exp. Surg.(Minn.). Second Edition. Baltimore, U.S.A.: The Williams & Wilkins Co., 1949. 5½" x 9", xii plus 546 pp., 330 figs. Price: 52s. 6d.

The first edition of this work, published in 1937, was a valuable presentation of the subject, and in the present volume the text has been enlarged and the references to literature modified and brought up to date.

As stated in the review of the previous volume, this work is an excellent introduction to the subject of experimental surgery. This subject has become "a respected and orthodox branch of instruction in medical schools," and though not well developed in Australia, nevertheless the experimental approach is often used by graduates carrying out investigations of various kinds. To these this book will be of very considerable value.

The new edition includes "surgical physiology" in its title, and the discussion of numerous problems and results of experiments justifies this. The material is well presented and the book is pleasant to read—the classical allusions in the new edition are a pleasant addition. The book should be read by all young surgeons whether they approach their problems by way of the experimental animal or not. It will be found of use also to laboratory workers whose work takes them through this field.

The volume is of the usual high standard of such works. It is easy to read and the illustrations, mainly drawings, are clear with satisfactory captions. The references given at the end of each chapter are well chosen and form a useful introduction to the literature of each field.

#### A COMPANION IN SURGICAL STUDIES.

By IAN AIRD, Ch.M., F.R.C.S. Edinburgh, Scotland: E. & S. Livingstone Ltd., 1949. 7" x 9½", viii plus 1,060 pp. Price: 63s.

In his introductory chapter the author of "A Companion in Surgical Studies" discusses, from the viewpoint of the advanced student, the relative value of the original article or monograph in his reading, as opposed to the textbook, even when this is of multiple authorship.

Ideal though the monograph may be, it must be agreed that the field open to the enquiring student is now so vast that he must often resort to something of a short cut and rather more readily available. Professor Aird has set himself to produce a "Companion" to which the apprentice may turn for "ready and rapid access to the ever-growing canon of established surgical fact," and where he may become aware "of the surgical conquests of the past, the tactics of the present and the strategy of the immediate future."

To further use the author's own words, "I have tried to pre-digest the written work of others by the enzymes of a personal experience admittedly limited." Introductory chapters often fail to attract readers. It is to be hoped that this one, which both from its content and its style well repays careful study, will escape that fate. The field covered in the forty-six chapters is truly vast, appearing to embrace the whole of surgery, with the exception, designedly, of orthopedics and fractures, in which mechanical principles are perhaps more particularly concerned than those basic facts of anatomy, physiology and pathology, which underlie and more completely dominate the practice of surgery in all other fields.

As must be inevitable in any work which covers such a huge field, certain inequalities appear. Those subjects which the author has made particularly his own are of outstanding merit. Perhaps nowhere is this more apparent than in the chapter, of some eighty pages, devoted to the surgery of the stomach,

including as it does the stormy and controversial field of the treatment of gastro-duodenal haemorrhage, which is treated in admirable fashion.

Worthy of special mention, too, is the chapter of equal length upon the surgery of the arteries. That which follows it, upon the veins, is equally good and in it the problem of phlebothrombosis is well covered. Mention must be made of an excellent chapter upon intestinal obstruction and strangulation.

Not the least valuable feature of the book is the very wide bibliography, deriving in the main from recent British and American sources, enabling the student or teacher to refer rapidly to an original paper. Some inaccuracies appear in this, it may be mentioned, which it is hoped will be corrected in future editions.

It is obviously impossible in reviewing a work of this magnitude to discuss it chapter by chapter. One criticism that appears fair is that the author, who admits to a particular interest in pathology, allows himself to devote a rather undue amount of space to the discussion of rare conditions—e.g., pre-aortic fistula, which are no doubt of great embryological interest, but of little practical importance. This subject has, in fact, more space allotted to it than that given to the treatment of acute appendicitis and appendical abscess. The latter, it may be remarked, Professor Aird prefers to approach by an extra-peritoneal route rather than through the free peritoneal cavity. Earlier, however, he has sagely remarked that surgery is learnt by apprenticeship and not from textbooks, and no doubt the student will learn in the theatre of the teaching of J. B. Murphy in this respect.

A more serious defect is that in the inevitable condensation and pre-digestion of the written work of others "by the enzymes of a personal experience," errors have crept in. Outstanding examples of this are to be found in the sections dealing with hydatid, both of the liver and of the lung. An apparent unfamiliarity with the essential pathology of these conditions has led to recommendations in treatment fraught with the gravest danger.

Condensation and brevity are, of course, inevitable, but a risk arises that the reader may be content with the abridgment and seek no further. If, for example, he attempted to carry out a Harris' prostatectomy so fortified, he would fall into grievous error, for the description of the operation is quite misleading. Equally unfortunate would be the young surgeon who attempted to excise a stricture of the urethra by the method of Hamilton Russell (which incidentally is not a modification of Wheelhouse's operation) if he followed the description as given.

The author has set himself a Herculean task and these criticisms may seem unduly severe. Despite them, it may be said that he has compiled a work of very real worth, even as a source of bibliography alone, and one which is very well indexed.

There are certain errors and omissions both in the references to authors and in the text which

can be rectified, and it is in the hope and expectation of seeing them made good that attention has been drawn to them.

#### A PRACTICE OF ORTHOPAEDIC SURGERY.

By T. P. McMURRAY, C.B.E., M.B., M.Ch., F.R.C.S. (Edin.) Third Edition. London, Eng.: Edward Arnold & Co., 1949. 5½" x 8½", viii plus 444 pp., 191 figures. Price: 30s.

The third edition of Professor T. P. McMurray's book, "A Practice of Orthopaedic Surgery," contains some alterations and additions, but, in the main, follows the pattern of its predecessors. The author is to be congratulated on restricting his volume to 430 pages. Fractures are not dealt with, but the student is presented with a precise and authoritative survey of orthopaedic surgery which is just what he requires. It gives him an insight into many conditions that he meets in his clinical years which are not adequately dealt with in his lectures or standard textbooks.

Professor McMurray has taught many generations of students and post-graduates and rightly emphasises principles as the basis for sound practice in orthopaedic surgery. The Liverpool School is often accused of undue conservatism, but it must be remembered that this is the result of long years of experience stemming from Hugh Owen Thomas and Robert Jones. In this book it is not surprising to find that the operative treatments advocated are those which have stood the test of time. But a proper emphasis is given to Nature's powers of restoration of function when aided by the skilful use of splints, manipulations and muscle re-education. In these days, when plaster of paris is the universal splintage method, it is well that the surgeon's attention should be directed to the advantages of the Jones' abduction frame, the Thomas' posterior spinal support, and the various forms of skeleton splints used for the hand and the foot.

Illustrations throughout the book are numerous and well placed in relation to the text, though some X-ray reproductions require revision. It is felt that illustrations should conform to the text. That demonstrating the use of the Thomas bed knee splint shows a limb with the knee flexed 30 degrees; while on the opposite page the direction is given "to place a large pad of wool between the back splint and the back of the knee joint in order to retain the knee at a position of 5 to 10 degrees flexion." Again the abduction arm splint, as illustrated, rests unequivocally on the crest of the ilium, the site of election with splint makers; while the author rightly stresses that "the weight of the splint is borne on the longer transverse bar, which should take its pressure on the strong fascia between the trochanter and the iliac crest." But these are small matters for criticism. "The Practice of Orthopaedic Surgery" is a first-rate publication, which should be in the library of every medical school. There is little glamour in the treatment of flat feet, knock knees and many other orthopaedic conditions, but the practitioner who knows how, will enhance his reputation and earn the thanks of his patients.

### Books Received.

#### CONFRONTATIONS RADIO - ANATOMO - CLINIQUES.

Fascicule III.

Published under the Direction of M. CHIRAY, R. A. GUTMANN and J. SENEQUE. Paris, France: Masson et Cie, 1949. 10" x 13", 80 pp., 150 figures. Price: Not stated.

#### TREATMENT IN PROCTOLOGY.

By ROBERT TURELL, B.S., M.D. (With a chapter on Psychosomatic Problems by LOUIS LINN, M.D.). Baltimore, U.S.A.: The Williams & Wilkins Co., 1949. 6" x 9", xiv plus 248 pp., 85 figures, 9 plates. Price: 75s. 3d.

## ADDENDUM.

The following index should be added to the article entitled:

OBSERVATIONS ON THE COURSE OF RECOVERY AND LATE END RESULTS IN A SERIES OF CASES OF PERIPHERAL NERVE SUTURE

by Professor Sydney Sunderland, which was published in the *Australian and New Zealand Journal of Surgery*, volume XVIII (1948-49), pages 264-341.

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